Study on Evaluating Genetic Variability of Gladiolus (*Gladiolus grandiflorus*) Cultivars under Agro –Climatic conditions of Prayagraj

Abstract

The name gladiolus was coined from Latin word *gladiolus*, meaning a sword because of shape of its foliage. Its common name is “corn flag" in Europe because *Gladiolus Illyricum* is found wild as weed in corn fields. It is also known as "water fall gladiolus" as it was found growing near the Victoria falls in the tropical forests of Africa. A field experiment was conducted at the Departmental research field of Horticulture, Naini, Agriculture Institute during Rabi season of 2023-2024. The experiment involved 22 cultivars arranged in randomized block design with three replications. The analysis of the data showed that phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all characters studied, indicating that environmental factors had a significant influence on these characters. Several traits, including number of leaves at 30DAS, corm yield per plant, number of cormels per hectare, cormel diameter, number of corms per hectare, and number of corms per plant, exhibited high PCV and GCV. Furthermore, the study found high heritability coupled with high genetic advance as a percentage of the mean for traits such as the number of leaves at 30DAS, corm yield per plant, number of cormels per hectare, cormel diameter, number of corms per hectare, and number of corms per plant. This suggests that these traits are under strong genetic control and have the potential for effective selection and improvement. The heritability estimates were found to be high (more than 75%). Genotypic and phenotypic correlation coefficient analysis revealed that Corms weight/plant (g) showed positive significant association with plant height, number of leaves per plant, number of shoot per plant, rachis length (cm), no. of floret per spike, no. of spike per plant, floret diameter (cm), corm weight per plot (g), weight of mother corm per plot, weight of daughter corm, corm diameter (cm), no. of corm per hectare, no. of cormels per hectare and corm yield/plant at both levels genotypic and phenotypic. Findings of the study showed that, in Prayagraj's agroclimatic conditions, genotypes Yellow Stone, Joshka, Pusa suhagan, and Arka Naveen were the highest spike and corm-yielding genotypes. Overall, the study shows how environmental conditions significantly affect the qualities that are seen and offers insightful information about how to choose gladiolus genotypes that have desired attributes for cultivation in the Prayagraj region.

Keywords: *Gladiolus, Genotypes, Genetic variability, GCV, PCV, Growth, yield and quality.*

INTRODUCTION

Floriculture is getting importance as a good source of income apart from giving pleasure and happiness. More than 150 countries are involved in floriculture trade worldwide. Approximately covered area by bulbous ornamentals in the world is 50,000 ha out of which gladiolus is cultivated in 9500 ha. In India approximately 3500 ha area is covered by bulbous ornamentals in which gladiolus is cultivated more than 1200 ha with an annual production of 707 million spikes (NHB, 2013), followed by tuberose (800 ha). In this way, gladiolus or sword lily (***Gladiolus spp***.) is the most popular ornamental bulbous plants commercially grown in our country for its excellent spikes with array of colors.

The genus of gladiolus includes about 200 species with more than 10,000 cultivars of which about 20 are grown commercially for cut flower purpose and many others are used as seasonal flowering plants in gardens and exhibitions. The colour range in gladiolus is fantastic and almost any color from near black to white, pink, violet, lilac or mauve, greenish, "smoky" and combination of these colors.

The name gladiolus was coined from Latin word *gladiolus,* meaning a sword because of shape of its foliage. Its common name is "corn flag" in Europe because *Gladiolus Illyricum* is found wild as weed in corn fields. It is also known as "water fall gladiolus" as it was found growing near the Victoria falls in the tropical forests of Africa. It was introduced into cultivation towards the end of the 16th century.

"Its commercial production for spikes in the last two decade has grown and became a very popular flowering plant in India. It has been found that commercial floriculture has higher potential per unit area than most of the field crops and is therefore a lucrative business for farmers. Government has taken various steps to develop the floriculture sector through the

Agriculture and Processed Food Product Export Development Authority (APEDA). Model centers have been established both in private and government sector for handling of cut flowers. India exported floricultural produce worth Rs. 450 cores" (APEDA 2016).

Gladiolus is a herbaceous plant that sprouts from axillary buds of the underground corm which is a vertical compressed stem covered with dried leaf bases. The leaves of the plant are two ranked in opposite directions and may be 15 to 120cm long and only and only 3 - 5cm wide. Its inflorescence is a spike earing large number of florets arranged alternatively on the axis in opposite directions and opening one by one acropetal manner. Most of this genus are primarily heteroploidy with tiny chromosomes (n=15), contrasting with polyploids like diploid (2n=30), triploid(2n=3x=45), tetraploid (2n=4x=60), hexaploidy (2n=6x=90) and octoploid (2n=8x=120). Modern cultivated gladiolus are tetraploids, majority of the South African species are diploid.

Flowers may be frilly, ruffled or plain, solid colored or multi-colored and they come in every shade and color combination imaginable. This crop is largely exported to European countries especially during winter. It is also popular decorative plant for use in herbaceous borders, bedding, and for growing in pots and bowls. The spikes are used in vase arrangements, in bouquets and for indoor decorations. The upright growth habit of gladiolus lends itself to any manner of floral a arrangements, from minimalist Japanese 'Ikebana' and 'Baroque'.

"The popularity of this crop as a cut spike is increasing day by day because of its long keeping quality and exhaustive range of the spike. the leading geophytes grown worldwide garden displays. It occupies a pristine place in the garden for its magnificent inflorescence, wide array of colours, and fascinating varieties of different shapes and sizes" **(Pragya et al., 2010)**

Genetic Heritability

Heritability is the term used in genetics and plant breeding programmed that is used to measure the variation in a phenotypic trait, which is due to variation of gene between the individual in that population (Wray and Visscher, 2008). Heritability in other word estimates the fraction of phenotypic variation, which can lead to the genetic variation.

Only the genetic components of variation which are transmitted to next generation is very important factor in plant breeding programmed. The degree of contribution of genotype variation to phenotypic variation for the characters in a group is expressed as the ratio of genetic variance to phenotypic variance for the trait. The ratio of genotypic variance to phenotypic variance for the trait in a population is known as heritability. The estimated range of Heritability is from Zero to One. Heritability which is close to Zero indicates

variability in a trait among population which influence is totally caused by Environmental factors with little influence of genetic differences. A Heritability close to One indicates variability of trait among the population which influence is totally cause by genetic differences with very few influence of environmental influence.

It can be expressed

as, H = Vg / Vp

Or, H = Vg (Vg+Ve)

Where Vg = Genetic variability

Vp = Phenotypic variability

Ve = Environmental variability.

Heritability can be estimated by three methods which include analysis of variance, calculation of genetic and environmental variance and regression. Heritability which are estimated by using these three methods is known as broad sense of heritability. It is denoted by (h^2) and expressed in per cent. For homozygous lines or population the estimated broad sense heritability are valid. Genetic variance consists of additive and dominance gene component to the total phenotypic variance is narrow sense heritability.

Genetic Variability

The magnitude of variability present in a crop species is importance for effective selection. The phenotypic variation in population is due to genotypic and environmental effect. Phenotypic variation is observable variation in a population which includes both genotypic and environmental components which results that its magnitude differs due to environmental conditions whereas genotypic variation is the component of variation which is due to gene difference among the different individuals in a population. Fisher (1918) divides genetic variance into three components as additive variance, dominance variance and epistatic variation. Genetic Variability is the term used in plant breeding programme which is the presence of different gene actions in the individual. Variability is a measurement of the trait that varies in response to genetic and environmental influence. The causes for genetic variability are due to fertilization between random sample, recombination or crossing over during meiosis, and mutation.

Correlation coefficient analysis

Correlation coefficient is the mutual relationship between two or more variables that determine or estimate the component characters on which selection can be based for improvement. It is important to study about the morphological variations and identification of suitable germplasm along with the evaluation of cultivars for improvement of the crop.

Genetic Advance

It is the improvement in the mean genotypic value of selected plants over the parental population. The measure of genetic gain under selection is said to be Genetic advance. If the amount of genetic variability is high then genetic advance is also high with this intention of above significance of the gladiolus crop, the current study was proposed in the Department of Horticulture, SHUATS, Prayagraj with the following objectives to enable the farmers for this vicinity to incorporate its cultivation with serious efforts.

JUSTIFICATION

The topic proposed for the research work **"Study on Evaluating Genetic Variability of Gladiolus (*Gladiolus grandiflorus L.*) Cultivars Under Agro- Climatic Conditions of Prayagraj"** Gladiolus is becoming popular now a days and is widely grown all over India not only as cut flower but also as pot and bedding plant. Few varieties of Gladiolus have gained important as cut flower varsity in Utter Pradesh climatic condition. Genetic variability in a group of cultivars is a prerequisite for a successful breeding programmed. Since, most of the characters influencing yield are polygenic, it is essential for plant breeders to estimate the type of variation available among the cultivars. Thus, a research work will be **"Study on Evaluating Genetic Variability of Gladiolus (*Gladiolus grandiflorus l.*) Cultivars Under Agro- Climatic Conditions of Prayagraj"** at horticulture research farm, SHUATS, paryagraj in the year 2023-2024.

OBJETIVES

1) To estimate genotypic and phenotypic coefficient of variation, variability and stability for different traits of gladiolus.
2) To study the correlation between spike yield and its contributing traits.
3) To work out Genotype and Environment interaction for different quantitative traits in gladiolus.

REVIEW OF LITERATURE

The quality and quantity of the crop can be improved by observing various genetic resources via crop breeding programme. The information on nature and magnitude is highly required to observe the genetic variability of the plant material or the crop which is associated with the typical characters and is a requisite for improvement in the yield. Additionally, knowledge of desired characters within the species enables the breeder in determining the most potential parental traits. Hence, the genetic potentialities for yield and its contributing character their relationship should be properly assessed and must be applied practically for yield improvement.

Brief review of relevant literature on gladiolus and other related flower crops are represented under the following headings.

2.1 Estimation of genetic variability, GCV, PCV, Heritability (H^2), Genetic advance

Nazir *et al.*, (2023) "analysis of variance for all the traits showed significant differences among genotypes for all the flower and yield related traits. High range in mean performance has been observed for traits, viz. plant height (79.13 cm - 125.10 cm), no. of leaves (5.00 - 8.00), leaf area (61.00 cm2 - 114.47 cm2), number of florets per spike (8.60 to 14.73), spike length (59.13 cm -105.10 cm), Rachis length (33.63 cm - 71.90 cm), durability of first floret (4.60 - 8.63 days), flower duration (12.07-17.83 days), stem diameter (5.50 cm to 15.70 cm), floret size (4.36 cm to 7.26 cm), vase life (7.10 to 9.96 days), chlorophyll content (41.90 - 58.59), number of corms (1.66 - 3.66), weight of corm

per plant (11.63 g - 36.63 g), diameter of corm (3.26 cm - 5.43 cm), numbers of cormels per plant (11.20 - 22.80)".

Vinutha *et al.*, (2023) reported that "the magnitude of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV). The highest GCV and PCV was observed for number of spikes per plant (38.06), numbers of corm per clump (33.48), days for first to last floret opening (29.88) and vase life of flower (29.63). Among the traits studied the highest heritability estimates was recorded in spike length (99.95%), plant height (99.86%) and days for first floret opening (99.77%). Genetic advance as percent mean was the highest for number of spikes per plant (75.23) and number of corms per clump (61.64). High heritability combined with high genetic advance was noticed for number of spikes per plant and number of corms per clump indicating there was additive gene action in expression of these traits and thereby further improvement could be made by selection".

Chandra *et al.*, (2023) reported that **"**the analysis of variance indicated extremely significant variations between genotypes. Number of spikes per plant had the highest phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), (35.81 and 23.41, respectively). For all of the traits studied, the phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV), while the differences were very small, indicating that the environmental influence on traits was low. The heritability estimates ranged from 42.75 (number of spikes per plant) to 99.01 (spike weight). This indicated that environmental variables had the least influence on these features. For most features, the estimated genetic progress as a percentage of mean varied from moderate to high. This finding, together with the high heritability values observed, suggested that additive gene action may exist and that simple selection for such traits may be used to improve them".

Lepcha *et al.* (2007) conducted "variability studies in gladiolus and reported that the moderate estimates of GCV and PCV were observed for plant height".

Number of leaves at flowering stage:

Poornima *et al.* (2007) studied "variability and correlation in different cultivars of china aster and recorded that number of leaves showed high GCV". **Deepti Singh and Misra (2008)** conducted "an experiment on genetic variability in quantitative characters in marigold and reported that high PCV and GCV values were observed for number of leaves".

Pratap and Manohar Rao (2006) conducted "assessment and variability studies in

gladiolus and observed moderate estimates of GCV for days to 50 per cent flowering". **Suma and Patil (2006)** conducted "an experiment on genetic variability and character association studies in daisy genotypes and reported that days to 50 per cent flowering showed low PCV and GCV values".

2.2 Estimation of genotypic and phenotypic correlation and path coefficient analysis

Nazir *et al.*, (2023) study their "genetic parameters such as variability, heritability and coefficient of variation, Analysis of variance for all the traits showed significant differences among genotypes for all the flower and yield related traits. The magnitude of correlation coefficient at genotypic level was found higher than the corresponding correlation at phenotypic level. Number of florets per spike had a positive and highly significant correlation both at genotypic and phenotypic levels with spike length (0.923, 0.956), rachis length (0.769, 0.956), weight of corm per plant (0.383, 0.299), number of cormels per plant (0.327, 0.3100) and diameter of corms (0.326, 0.251) respectively".

Singh *et al.*, (2023) "results of investigation revealed that for yield improvement through selection emphasis should be given on the characters like Plant height, Spike length, Rachis length, No. of shoots per plant, No. of corms per plant. Especially the emphasis may be laid down upon the Plant height, Number of florets or Diameter of the floret, since these characters had highly significant and positive correlations with Spike length so a direct selection from genotypes will be more effective for improvement of this crop".

Gangadharappa *et al.* (2008) studied on "genetic correlation, heritability and genetic advance in tuberose and reported that the days taken for basal floret to open recorded low PCV and GCV".

Zala *et al.*, (2023) "the analysis of variance revealed significant differences among the genotypes for eleven characters in dahlia *viz.*, plant height, number of leaves per plant, number of branches per plant, stem girth, days taken to first bud initiation, diameter of flower, stalk length, vase life, anthocyanin content, chlorophyll content and flower yield which indicated the existence of variability in the experimental material. The estimates of genotypic (σ^2g) and phenotypic variances (σ^2p) of each character were carried out".

Sanketh *et al.*, (2024) revealed that "plant height (0.885), leaf length (0.700), leaf area (0.670) and number of florets per stalk (0.691) with stalk length showed a significant positive correlation, whereas plant height (-0.782), number of leaves (-0.657), leaf length (-0.778), leaf area (-0.874), intermodal length (-0.767) and stalk length (-0.686) showed significant negative

correlation with days taken for stalk emergence. Path analysis revealed that the number of cut flowers per m2 exhibited a highly positive direct effect with the plant height (0.479), leaf area (1.001), number of florets per stalk (0.417) and stalk girth (0.448). This suggests that these are the potential traits in improving the earliness, stalk quality and marketable flower yield. Therefore, greater emphasis is given to these traits while selecting the genotypes for crop improvement".

According to **Balamurgan *et al*., (2002)** reported that "the genotypic of variation of variation were highest for the number of cormels produced per plant (105.34%). Followed by number of corms (103.94%) and number of side shoots (54.67%). Similar trend was also observed for phenotypic coefficient of variation. Highest GCV and PCV were for number of corbels produced per plant. Lows GCV and noted for longevity of individual florets (6.10%) followed by drain of first florets (10.46%) and leaf length (10.98%)".

In a study of **Person (2001)** studied "on estimating genetic variability in horticultural crop species at different stages of domestication. Some genetic aspects were studied in five crop species. The first step in the domestication process involved the selection of plant material in nature, often only a small Amount of the variation present in the source material was represented in the samples taken. No variation at all was found in cultivated material".

An experiment was conducted by **Sakkeer *et al.*, (2001)** studied "between different character and the direction and magnitude of different characters towards total number of florets per spike in several genotypes of gladiolus grown over four planning seasons in Delhi. Among these characters studied days to 50 percent heading recorded maximum positive direct effect towards number of florets per spike while days to first floret showing colour showed maximum indirect positive effect".

According to **Manoi *et al.*, (2001)** studied "on correlation analysis were carried out among 22 diverse genotypes of gladiolus for 20 characters and related to growth and flowering. It showed positively significant association with plant height, which ultimately increases the rachis length, thereby increasing the value of the genotype".

In a study of **Neeraj *et al.*, (2001)** studied "on correlation and path coefficient analysis were carried out on 26 genotypes of gladiolus. The number of florets per spike showed highly significant positive correlation with plant height, size of first floret, length of rachis. Maximum positive direct effect on number of florets per spike was shown by

days. To first floret showing colour followed by duration of flowering, length of rachis and days to spike initiation, while maximum negative direct effect was shown by days to first floret opening".

MATERIALS AND METHODS

This chapter contains the details of the material used and methods adopted for the present thesis in Prayagraj Agro-climatic condition." was carried out at the experimental plot is located at Department of Horticulture, SHUATS, Prayagraj, U.P. The materials used and statistical methods followed during the course of investigation are given below:

1.1 Experimental Site

The experiment was conducted at the Departmental research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, located between 25.87°North latitude 81.15° East altitude. The altitude is 78 meters above the mean sea level.

1.2 Climate

Prayagraj is situated at an elevation of 78 meters from mean sea level at. 25.8°N latitude and 81.5°E longitude has a typical subtropical climate with extremes of summer and winter. During the winter months, especially during December and January, the temperature drops down to as low as 1°C while during summer the temperature reaches more than 45°C. Hot scorching winds (Loo) are a regular feature during summers. The average rainfall is about 100 cm and occurs mostly during July to September, with a few occasional showers during the winter months. The meteorological data recorded during the crop growth period has been presented in table 1 and depicted through figure

1.3 Soil analysis

Prior to the start of the experiment, the physical and chemical analysis of the experimental field soil was done to find out. The initial fertility status of the soil, the procedure for the

soil analysis is given below

1.4 Soil sampling

Soil samples were collected randomly from different places in the experimental plot with the help of soil auger from soil surface up to 12-15 cm depth. The soil samples were mixed properly. A representative sample of 5gm soil for analysis was then taken and subjected to physical and chemical analysis.

Table 1 Mean weekly weather parameters and total rainfall during the cropping season (October 2023- March 2024)

Weeks	Temperature^0 C		Rainfall (mm)	Relative humidity (%)	
	Maximum	Minimum		Maximum	Minimum
October					
4th week	32.4	16.40	0.00	93.00	56.00
November					
1st Week	31.90	17.57	0.00	94.00	56.70
2nd week	30.71	16.63	0.00	88.71	57.91
3rd week	30.31	15.24	0.00	83.90	52.60
4th week	27.82	11.90	0.00	88.97	58.63
December					
1st Week	25.57	10.80	0.00	93.43	58.29
2nd week	26.31	11.00	0.00	93.71	53.14
3rd week	25.48	9.85	0.00	93.71	61.71
4th week	24.14	9.28	0.00	94.10	62.60
January					
1st Week	18.63	7.46	0.00	93.43	63.86
2nd week	18.57	7.60	0.00	93.71	62.14
3rd week	21.80	8.06	0.28	93.71	62.71
4th week	25.64	11.42	1.34	87.60	54.90
February					
1st Week	24.23	10.89	0.00	79.14	44.14
2nd week	26.83	13.00	0.00	74.57	44.29
3rd week	28.26	11.86	0.00	77.43	43.57
4th week	32.91	13.71	0.00	75.00	41.71
March					
1st Week	34.71	13.63	0.00	74.57	39.43
2nd week	34.97	14.89	0.00	75.86	39.71
3rd week	32.66	14.43	3.77	79.14	51.29
4th week	31.43	18.23	0.71	67.57	46.60

Source: Agro-meteorological Department, School of Forestry and Environment, SHUATS, Prayagraj

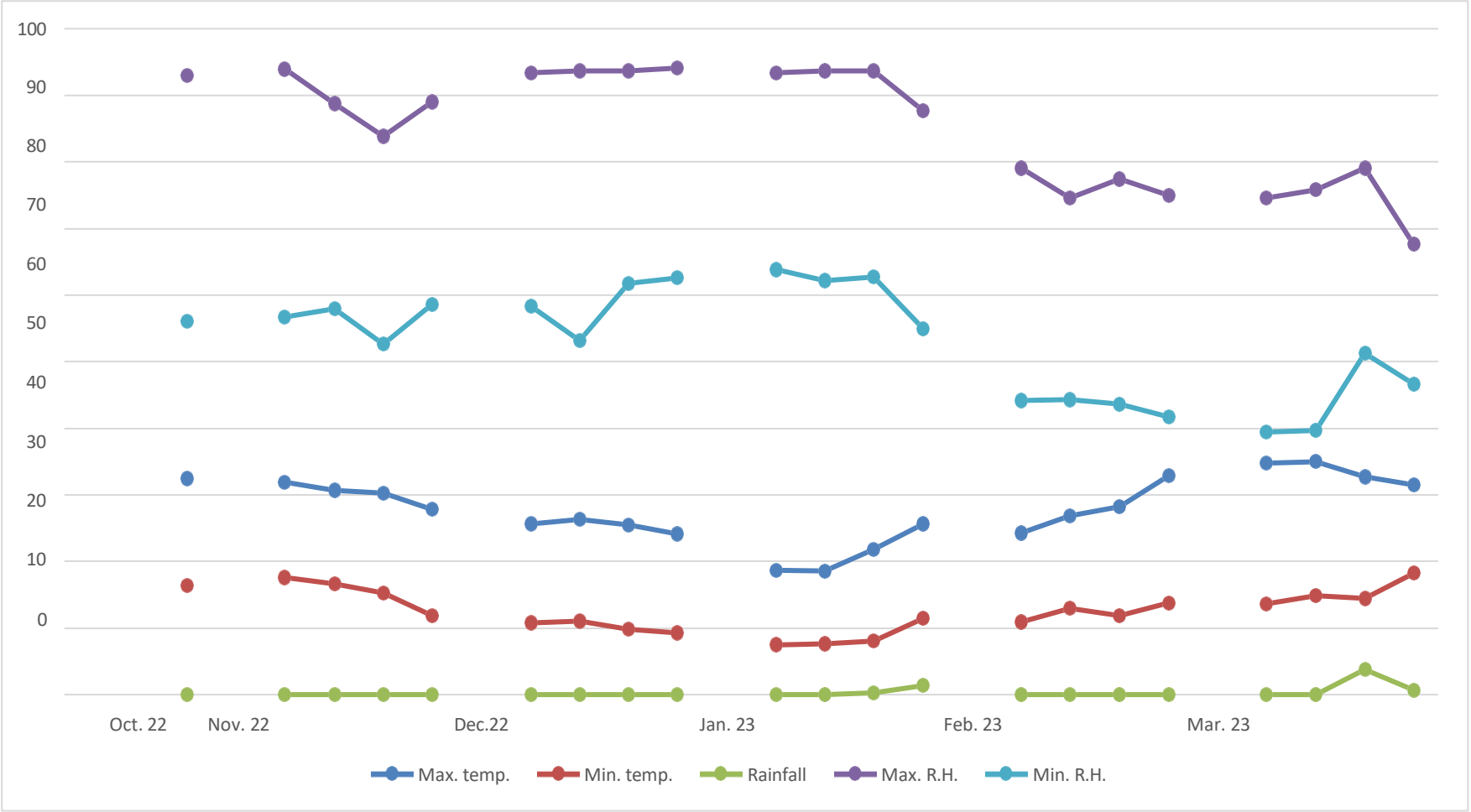

Fig. 1 Mean weekly weather parameters and total rainfall during the cropping season (2023-2024)

1.4.1 Physical analysis

The physical analysis of soil sample was done by the help of International Dispersion Method and the result of the analysis is given below:-

Table 2 Physical composition of soil

S.No.	Soil properties	Percentage %
1	Sand	60.60
2	Silt	22.41
3	Clay	18.30
4	Bulk Density	1.64
5	Textural classes	Sandy loam

1.4.2 Chemical analysis

The chemical analysis of the soil was performed to determine the percentage of nitrogen, phosphorus, potassium, organic carbon and organic matter content. The nitrogen was determined by Tread well and Hall's' modified 'Kjeldahls method'. Phosphorus was determined by 'Olsen Calorimetric method' and available potassium by Flame Photometer. The organic matter was estimated by 'Hydrochloric Acid Oxidation method' as suggested by Walklay and Black (1971). Electric pH Meter helped to measure the soil pH. The result of the soil analysis has been presented in table.

Table 3 Chemical composition of soil

S.NO.	Ingredients	Quantity	Method used
1.	Soil ph	7.2	Digital pH metre (M.L. Jackson)
2.	Organic Carbon	0.4	Wet Method (Walkely and Black method 1934)
3.	Available Nitrogen(N)	100kg/ha	Alkaline permanganet method (Subaiah and Asija 1956)
4.	Available Phosphorus(P)	60kg/ha	Calorimetric Method (Olsen et al. 1954)
5.	Available Potash(K)	40kg/ha	Flame Photometric method (Jackson, 1967)

It is evident from the above tables that: the soil of the experimental plot was sandy loam in texture, poor in nitrogen, comparatively rich in phosphorus and potash with slightly alkaline in nature.

1.5 Cropping history of experimental plot

Before the commencement of this experiment, the selected field was fallow in the November 2022. The experimental field was in fairly good working condition and uniform in the fertility status and latitude.

1.6 Procurement of corms

The experiment material was obtained from Directorate Floriculture Research, Pune, India.

1.7 Preparation of field

The following operations were performed for the preparation of the soil before planting of corms in table 4

Table 4 Pre-field operation

Operation	Method
a. Primary	By Hoe and plough
b. Secondary	By using harrow and cultivator
c. Levelling and preparation of plots	By normal labour

1.8 Crop used

Gladiolus was taken as the experimental crop.

1.9 Source of fertilizers

For nitrogen fertilizer, Calcium Ammonium Nitrate @ 50 g/m2 was used. For phosphorus, single super phosphate @ 20 g/m^2 and for potash, Murate of Potash @ 20 g/m^2 was used.

1.10 Details of experiment

1.10.1 Design of experiment

The experiment was laid out in Randomized Block Design (RBD) with fifteen treatments, each replicated three times. The treatments were allocated randomly to a unit plot in each replication.

1.10.2 Layout description

Name of Crop : Gladiolus

Botanical Name : *Gladiolus grandiflorus L.*

Family : Iridiaceae

Design of experiment : RBD

No. of Replication : 3

No. of Plot : 48

Size of net plot : 1m×1m= $1m^2$

Total no. of corms : 1056

No. of varieties : 22

Width of Main irrigation : 100cm (1m)

Width of sub- irrigation : 50cm (0.5m)

Inner sub –border : 30cm

Outer main border : 30cm

Gross cultivated area : $156.6m^2$

Net cultivated area : $60m^2$

Spacing : 40cm x 25cm

Sowing season : Winter (2023-2024)

Location of experiment : Research field, Department of Horticulture

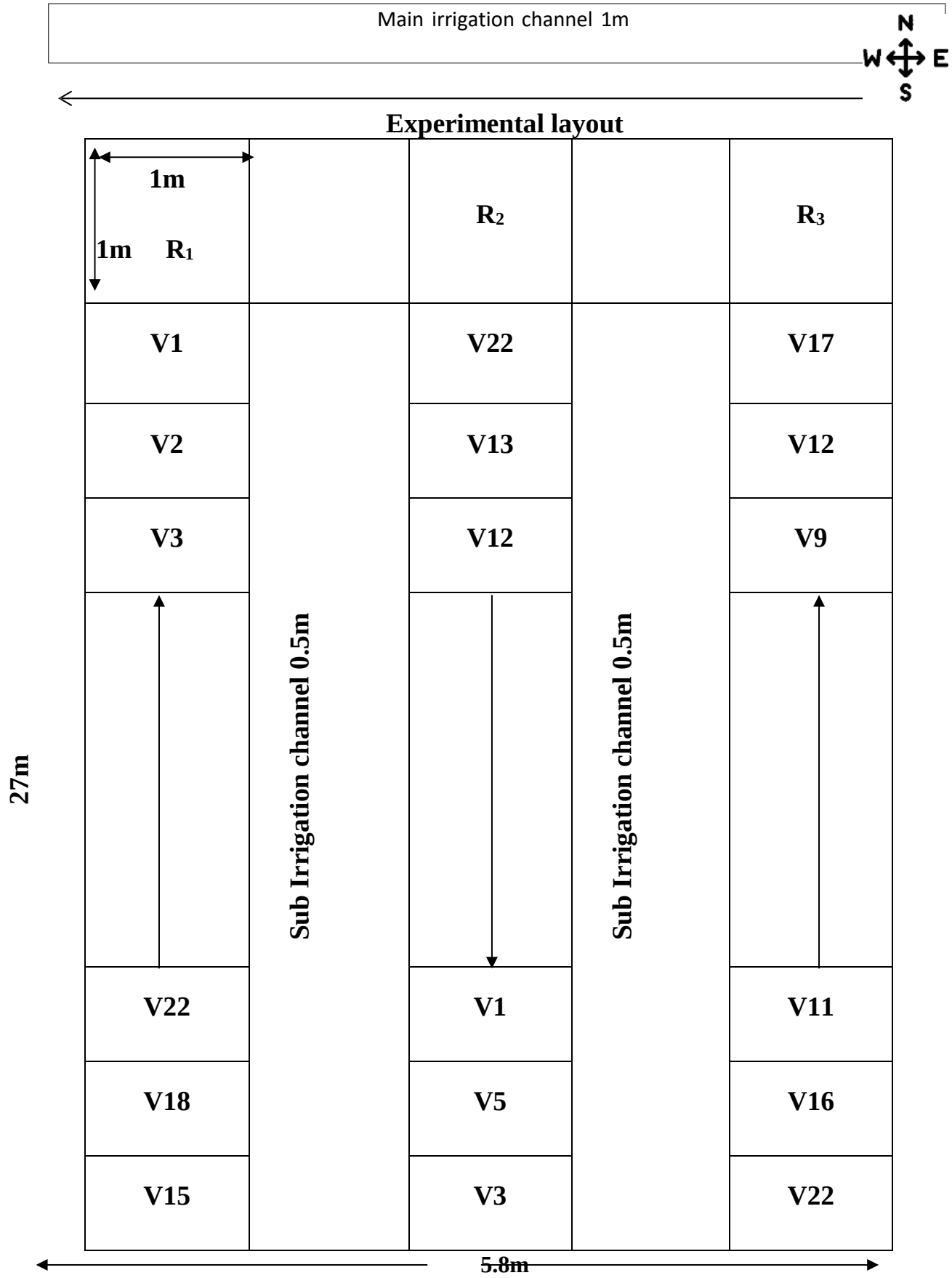

Fig 2: Layout of experimental field

Table 5: Treatments details:

The treatments included 22 cultivars of Gladiolus

S.No.	Notation	Genotypes	Source
1.	V1	SOUVIK BISCUITS	DFR, Pune
2.	V2	DHANVAN LARI	DFR, Pune
3.	V3	MANHITTAN	DFR, Pune
4.	V4	P.B. CLOWN	DFR, Pune
5.	V5	ARKA NAVEEN	DFR, Pune
6.	V6	JESTER	DFR, Pune
7.	V7	PUNJAB LEMON DELIGHT	DFR, Pune
8.	V8	URMI	DFR, Pune
9.	V9	ARKA PARTHAM	DFR, Pune
10.	V10	PRISCILLA	DFR, Pune
11.	V11	RED GINGER	DFR, Pune
12.	V12	ARKA TILAK	DFR, Pune
13.	V13	PHULE GANESH	DFR, Pune
14.	V14	ALY ANYQUE	DFR, Pune
15.	V15	CHANDNI	DFR, Pune
16.	V16	YELLOW STONE	DFR, Pune
17.	V17	PUNJAB FLAME	DFR, Pune
18.	V18	PUSA SUHAGIN	DFR, Pune
19.	V19	ARKA AAYUSH	DFR, Pune
20.	V20	P.S HYBRID	DFR, Pune
21.	V21	PHULE NEELREKHA	DFR, Pune
22.	V22	PUNAB BINK CHALNU	DFR, Pune

1.11 Agro-techniques

1.11.1 Field preparation

The experimental plot was selected and kept free from weeds by hand weeding after thorough ploughing, harrowing and planking. Well rotten farm yard manure was applied @ 2kg/m^2 about 10 days before planting of corms. The soil was thoroughly drenched with 0.2% chlorpyriphos one day before sowing of corms to control termites, ants, etc. Finally, the whole area was divided into 45plots each measuring 2 x 2 m.

1.11.2 Corm treatment

The corms were soaked in Bavistin solution (0.2%) for half an hour and then spread on newspaper to air dry for a night

1.11.3 Fertilizer application

Calcium ammonium nitrate (CAN), single super phosphate (SSP) and Murate of potash (MOP) were weighed in accordance to its requirement. Half dose of CAN with full doses of SSP and MOP was applied as basal dose one hour before sowing of corms. Remaining dose of CAN was applied at spike emergence s age.

1.11.4 Details of planting

Before planting, it was ensured that the plot had enough moisture and was properly leveled. Date of sowing of corms -

Distance of planting - 40 x 25 cm

Number of plot - 48

Total number of corms - 1056

Depth of planting of corms - 3-5 cm

1.11.5 Weeding

Regular hand weeding was done at an interval of 15-20 days from the day of planting and the last weeding was done after the completion of blooming period.

3.11.6 Earthing up

Earthing up was done 35 and 55 days after planting.

3.11.7 Irrigation

The plots were flooded on 2nd day after planting and thereafter whenever required or necessary. In total 12 irrigations were given.

3.11.8 Plant protection

First spray of monocrotophos 0.05% was done at the time of initial visibility of thrips and three sprays later done at an interval of 10 days. Also, three sprays of fungicides at an interval of 12 days were done.

1st Spray - Mancozeb 75 WP (3 g/1)
2nd Spray - Hexaconzole 5 EC (0.3 ml/1)
3ld Spray - Carbendazim 75 EC (0.5 g/1)

1.12 Observation recorded

1.12.1 Plant Height

Plant height (cm) was taken from ground level to the end of the last floret.

1.12.2 No. of Leaves/Plant

All the true leaves (except prophylls) present on the shoots was counted at the time of lifting.

1.12.3 Number of Shoots/Plant

The Number of shoots/hill produce was counted.

1.12.4 Days to 50% sprouting

Number of days required from sowing to 50% sprouting was recorded.

1.12.5 Rachis Length

Rachis Length (cm) was measured from the base of first floret to the end of last floret

1.12.6 Days to emergence of flower spike

Number of days required from planting to emergence of flower spike was recorded.

1.12.7 Number of days for to show color of basal floret

Number of days required from planting to basal floret showing colour was recorded.

1.12.8 Number of Florets/Spike

Total Number of florets per shoot was counted.

1.12.9 Number of Spikes/plants

Total Number of spikes per plant was counted.

1.12.10 Length of Floret

Length of floret (cm) was recorded on 3rd day

1.12.11 Diameter of Floret (cm)

Diameter of floret (cm) was recorded on 3rd day from apex of one wing petal to the apex of other.

3.12.15 No of corms produced per mother plant

Total Number of corms produced from a mother corm was counted at the time of harvesting of corms.

3.12.16 Diameter of corm (cm)

Diameter of corm was measured at its maximum horizontal width and expressed in centimeters with the help of digital vernier caliper and their mean was calculated.

3.12.17 Diameter of Cormel(cm)

Diameter of cormel was measured at its maximum horizontal width and expressed in centimeters with the help of digital vernier caliper and their mean was calculated.

3.12.18 Weight of Corm

Weight of corm (g) Produced/plant was divided by a number of corms/plants to get the average wt. of a corm.

3.12.19 Weight of Corm/Plant (g)

Total weight of corm produced from a single plant was recorded at the time of harvesting of corms.

3.12.20 No of cormels/ plant

Total Number of cormels produced from a single plant was counted at the time of harvesting of corms.

3.12.2 Diameter of cormels (cm)

Diameter of cormels was measured at its maximum horizontal width and expressed in centimeters with the help of digital vernier caliper and their mean was calculated.

3.12.21 No. of corms/ha

Total Number of corms produced per hectare area was calculated from total number of corm produced in a meter area.

3.12.22 Yield of cormels/ha

Total Number of cormels produced per hectare area was calculated from total number of cormels produced in a meter area

3.12.23 Corm yield/plant (g)

Total weight of corm produced from a single plant was recorded at the time of harvesting of corms.

4.13 Statistical analysis

The data was recorded on the above characters subjected to following statistical analysis.

4.13.1 Analysis of variance:

The data obtained from each environment will be subjected to analysis of variance as per the procedures outlined by **Sukatme & Amble (1989).** The pooled analysis of variance will be based on the following model **of Sprague & Federar (1951).**

$$Yijk = \mu + gi + ej + rjh + (ge)ij + eijk$$

Where,

Yijk = Means performance of ith Genotype in replication of the j^{th}

environment i = 1,2 .....,g

j = 1,2.....,n

k = 1,2.....,r

μ = General population mean

g_i = Effect of i^{th} Genotype.

e_j = Effect of j^{th} environment

r_{jk}= Effects of k^{th} replication at j^{th} environment

$(ge)_{ij}$ = Interaction effects

e_{ijk} = Random deviation of i^{th} Genotype in k^{th} replication of J^{th} environment

Table 6 : Skeleton ANNOVA

Source of variation	D.F	M.S.	E.M.S	F.Value
Replication with in environment	N(r-1)	M_1		
Environment (E)	(n-1)	M_2	$\sigma^2e + r\sigma^2ge + rg\sigma^2e$	M_2/M_4
Genotype(g)	(g-1)(n-1)	M_3	$\sigma^2e + r\sigma^2ge + m\sigma^2 g$	M_3/M_4
G x E	(g-1)(n-1)	M_4	$\sigma^2e + r\sigma^2ge$	M^4/M_5
Pooled error	n(r-1)(g-1)	M_5	σ^2e	

Where: g, n & r stands for the no. of genotypes, environments & replications respectively. The statistical significance of mean squares of environments and genotypes was tested against the mean squares due to g x e will be tested against the mean squares for pooled error.

3.14 Genotypic and Phenotypic:

Genotypic and phenotypic variance for individual environments was obtained with the help of following formula:

$$\text{Genotypic Variance} = \frac{\text{M.S} - \text{Error}}{\text{No. of replication}}$$

Phenotypic Variance = Genotypic Variance +Error M.S

For pooled environment the formula will be used

$$\text{Genotypic variance} = \frac{\text{G.M.S - G x E.M.S}}{\text{Rep. x Enviroment}}$$

Phenotypic Variance = Genotypic Variance + Pooled Error M.S

3.15 Coefficient of variance

The coefficient of variance will be cal. By **Burton & Devane** (1953) formula phenotypic coefficient of variance (PCV)

$$\text{Phenotypic PCV (\%)} = \frac{\text{Phenotypic S.d.}}{\text{General Mean}} \times 100$$

$$\text{GCV (\%)} = \frac{\text{Genotypic S.d..}}{\text{General Mean}} \times 100$$

3.16 Heritability in broad sense (%h^2)

Heritability will be calculated according to the formula suggested by Allard (1960).

$$H = \%h^2 \frac{\sigma^2 g}{\sigma^2 p} \times 100$$

Where,

H= Heritability Coefficient (in broad sense)

σ^{2g} = Genotypic Coefficient of variance

σ^{2p} = Phenotypic Coefficient of variance

As suggested **by Johnson et al. (1955),** heritability values are categorized as follow :

Less than30% : Low

30 to 60% : Moderate

More than 60% : High

3.17 Genetic advance:

The expected genetic advance will be cal. by Allard's formula – 1960

$$GA = (k)\ (\sigma p)\ (H)$$

Where,

k = selection differential constant, the value of which is 2.06 at 5% selection intensity.
σp = Phenotypic s.d
H = Heritability Coefficient

3.18 Genetic advance as percentage

$$\text{Genetic Adv. as \% of mean} = \frac{\text{Genetic Adv.}}{\text{General Mean}} \times 100$$

The range of genetic advance as per cent of mean is classified as suggested by **Johnson et al. (1955)**

Low : Less than 10%

Moderate : 10 to 20%

Higher : More than 20%

3.19 Correlation coefficient analysis:

The correlation coefficients among all possible character combinations at phenotypic (rp) and genotypic (rg) level were estimated employing formula by **Johnson et al. (1955).**

$$\text{Genotypic correlation } (G) = r_{xy} = \frac{Cov_{xy}(G)}{\sqrt{Vx(G) \times Vy(G)}}$$

$$\text{Phenotypic correlation } (P) = r_{xy} = \frac{Cov_{xy}(P)}{\sqrt{Vx(P) \times Vy(P)}}$$

Where,

Cov_{xy} (G) = Genotypic coefficient of variance between x and y Cov_{xy}(P) = Phenotypic coefficient of variance between x and y V_x(G) = Genotypic variance of character x

V_x(P) = Phenotypic variance of character x V_y(G) = Genotypic variance of character y V_y(P) = Phenotypic variance of character y

Test of significance

To test the significance of correlation coefficient, the estimated values were compared with table value of correlation coefficient prescribed by **Fisher and Yates (1938)** at (n-2) treatment degree of freedom at 5% and 1% level of significant. If the calculated value of correlation coefficient is greater than tabulated value, it is considered to be significant and vice-versa.

$$r = \frac{r^2 \times \sqrt{n - 2}}{\sqrt{1 - r^2}}$$

Display Photographs

Pic 1: Field inspection by Dr. Devi Singh (Advisor)

Pic 2: Harvested flowers Vase life evaluation by Dr. Devi Singh (Advisor) and Dr.Vijay Bahadur (HOD)

LIST OF PLATES

Plate 1. 10 DAS

Plate 2. 30 DAS

Plate 3. 45 DAS

Plate 4. Tagging

Plate 5. Tagging

Plate 6. Budding

Plate 7. Fertilizer Application

Plate 8. 60 DAS

Plate 9. Chandani

Plate 10. Arka Amar

Plate 11. Aly Anyque

Plate 12. Red ginger

Plate 13. Jester

Plate 14. Arka Aayush

Plate 15. Souvik biscuit

Plate 16. Arka naveen

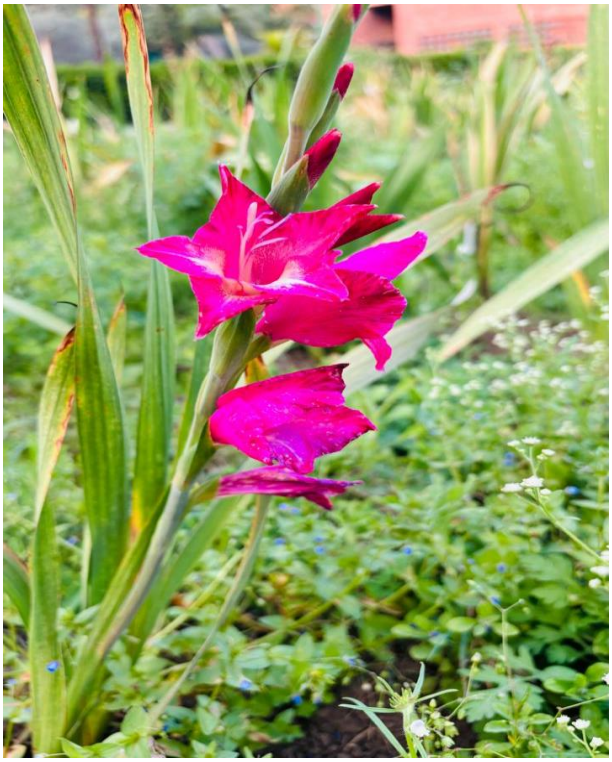

Plate 17. P B Clown

Plate 18. Arka Thilak

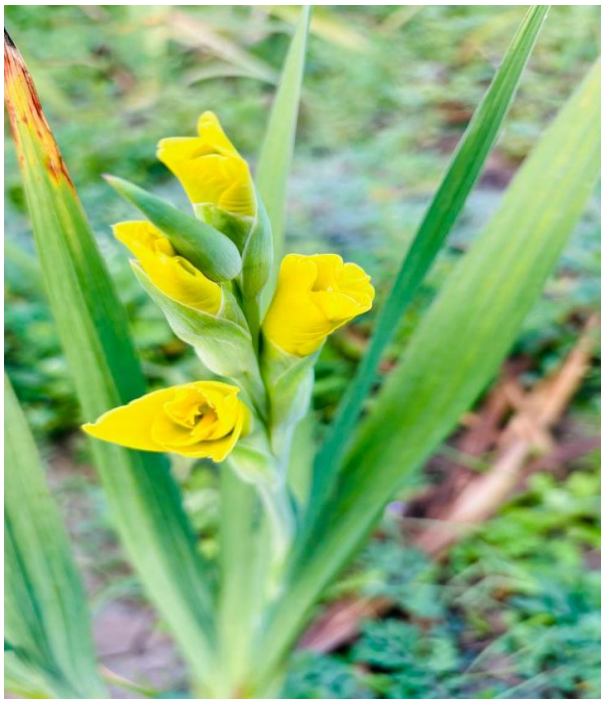

Plate 19.Yellow stone

Plate 20. Arka Thilak

RESULTS AND DISCUSSION

The results obtained from the present re-search entitled; **"Study on Evaluating of Genetic Variability of gladiolus cultivars under Agro-Climatic conditions of Prayagraj"** has been described in this chapter under the following headings:

4.1 Analysis of variance

4.2 Mean performance

4.3 Genetic variability, GCV, PCV, heritability and genetic advance

4.4 Correlation coefficient analysis:

4.1 **Analysis of variance**

Analysis of variance showed significant differences among the genotypes for the 22 characters studied analysis of variance showed significant difference among the genotypes for the different characters at 1% significance. The mean sum of squares due to genotypes showed significant differences for all characters under study for except days taken for emergence of flower spike and days taken to show color of basal floret. In other words, the performance of the genotypes with respect to these characters was statistically different, suggesting scope for growth, flowering and corm yield characters improvement in Gladiolus. The present investigation confirms the earlier finding **Bhujbal *et al.*, (2013), Ahmad *et al*., (2012) and Ramzan *et al*., (2016)**

Table 7: Analysis of variance for 24 different growth, flowering and corm yield of Gladiolus.

S.No.	Characters	Analysis of Variance			
		Replication df=2	Genotypes df=14	Error df=28	Total=44
1.	Plant height (cm) 30DAS	0.21	107.15**	4.12	36.73
2.	Plant height (cm) 60DAS	20.21	174.91	7.74	61.50
3.	Plant height (cm) 90DAS	17.08	172.41**	18.65	67.50
4.	Number of leaves per plant at 30DAS	0.07	41.35**	0.11	13.23
5.	Number of leaves per plant at 60DAS	0.04	23.20**	0.21	7.52
6.	Number of leaves per plant at 90DAS	0.62	14.12**	0.60	4.90
7.	Number of shoots per plant	0.001	0.500**	0.004	0.161
8.	Days taken for 50% sprouting	0.001	1.390**	0.065	0.484
9.	Rachis length(cm)	17.57	347.64**	4.63	114.36
10.	Number of days for emergence of flower spike	14.36	65.00**	9.06	27.10
11.	Days to show colour of basal floret	10.69	53.38**	10.98	24.46

12.	No. of florets per spike	0.42	8.51**	0.29	2.91
13.	No. of spikes per plant	0.000	0.467**	0.005	0.152
14.	Floret length(cm)	0.043	2.689**	0.173	0.968
15.	Floret diameter(cm)	0.319	2.991**	0.127	1.047
16.	No. of corms produced per mother plant	0.000	0.713**	0.005	0.230
17.	Corm diameter(cm)	0.01	0.341**	0.073	
18.	Weight of corms(g)	0.034	2.958**	0.036	0.966
19.	Weight of corms per plant(gm)	0.56	179.86**	4.37	60.03
20.	Size of corms (cm)				
21.	Cormel diameter(cm)	0.00	1.01**	0.00	0.33
22.	No. of corms/hectare	20843542	19793699048**	149260589	6393926597
23.	No. of cormels/hectare	56581729239	7389188389789**	27749460061	2371336040846
24.	Yield of corms/plant(g)	13.91	3932.11**	11.90	1259.33

**Significant at 1% level of probability

4.2 Mean performance of 22 varieties for growth, flowering and corm yield characters of Gladiolus (*Gladiolus grandiflorus L.*).

The mean values, range, grand mean, coefficient of variation, and critical difference of 15 gladiolus genotypes for all the 24 growth, flowering and corm yield characters are presented in (Table 8)

4.2.1 Plant Height (cm) 30 DAS

The character plant height (cm) at 30 DAS exhibited a wide range of variation from 32.90 to 52.56 with a grand mean 47.17. The highest plant height (cm) at 30 DAS of genotype Arka Aayush (52.56) followed by Punjab Plame (50.90), Punjab Lemon Delight (50.47) where minimum height recorded in Arka Pratham (32.90), P.B. Clown (42.45).

4.2.2 Maximum plant height at 60DAS

The character plant height (cm) at 60 DAS exhibited a wide range of variation from 61.76 to 81.60 with a grand mean of 72.68. The highest plant height (cm) at 30 DAS of genotype Arka Aayush (81.60) followed by yellow stone (114.83), P.B. Clown (114.57) where minimum height recorded in Arka Pratham (61.76), Phule Ganesh (64.52).

4.2.3 Maximum plant height at 90DAS

The character plant height (cm) at 90 DAS exhibited a wide range of variation from 99.06 to 118.57 with a grand mean of 106.65. The highest plant height (cm) at 30 DAS of genotype Arka Aayush (118.57) followed by Punjab Lemon Delight (114.93), yellow stone (114.83) where minimum height recorded in Arka Pratham (99.08), Dhanvan Lari (101.00).

4.2.4 Maximum number of leaves at 30DAS

The character plant leave (cm) at 30 DAS exhibited a wide range of variation from 2.05 to 4.87 with a grand mean of 3.90. The highest number of leaves per plant was observed in Arka Pratham (4.87) followed by Jester (4.83), Dhanvan Lari (4.80) where minimum no. of leaves recorded in Aly Anyque (2.05) and Phule Ganesh (2.20).

4.2.4 Maximum number of leaves at 60DAS

The character plant leave (cm) at 60 DAS exhibited a wide range of variation from 5.34 to 8.86 with a grand mean of 7.27. The highest number of leaves per plant was observed in Arka Pratham (8.86) followed by Arka Aayush (8.80), Yellow stone (8.57) where minimum no. of leaves recorded in Aly Anyque (5.34) and Punjab Lemon Delight (5.74).

4.2.5 Maximum number of leaves at 90DAS

The character plant leave (cm) at 90 DAS exhibited a wide range of variation from 9.25 to 13.34 with a grand mean of10.12. The highest number of leaves per plant was observed in Arka Pratham (13.34) followed by Jester (13.18), Dhanvan Lari (13.04) where minimum no. of leaves recorded in Aly Anyque (9.25) and Punjab Bink Chalnu (9.45).

4.2.6 Number of shoot /plants

The character Number of shoot/plant exhibited a wide range of variation from 1.22 to 2.25 with a grand mean of 1.76. The highest Amount of shoot/plant of genotype Arka Aayush (2.25) followed by P.B. Clown (2.20) and Manhittan (2.19). While lowest Number of shoot/plants was observed for Arka Pratham (1.22).

4.2.7 Maximum Days taken for 50% sprouting

The character Days for 50% flowering exhibited a wide range of variation from 3.16 to 6.64 with a grand mean of 5.80. The highest Days for 50% flowering of genotype was recorded in Gunjan (6.64) followed by P.B. Clown (6.04) and Panjab Bink Chalnu (6.06) where minimum days taken for 50% sprouting in Arka Aayush (3.16).

4.2.8 Maximum Rachis length

The character Rachis length (cm) exhibited a wide range of variation from 38.64 to 55.50 with a grand mean of 47.64. The highest Rachis length (cm) was observed in genotype was recorded in Arka Aayush (55.50) followed by Souvik Biscuits (55.10), Push Sunagin (53.34) where minimum rachis length recorded in Arka Pratham (38.64), Priscilla (49.43).

4.2.9 Maximum number of days for emergence of flower spike

The character maximum number of days for emergence of flower spike exhibited wide range of variation from70.04 to 83.22 with a grand mean 75.56. The Maximum number of days for emergence of flower spike was observed in Arka Pratham (83.22) followed by Urmi (82.02) Punjab Lemon Delight (81.25) where minimum number of days for emergence of flower spike Arka Aayush (70.04).

4.2.10 Maximum Days to show colour of basal floret

The character maximum days to show colour of basal floret exhibited wide range of variation from 78.37 to 92.64 with a grand mean 85.60. The maximum no. of days to show colour of basal floret was recorded in Arka Pratham (92.64) and Urmi (92.00) followed by Urmi (92.00), Punjab Lemon Delight (89.79) where minimum number of days show colour of basal floret Arka Aayush (78.37).

4.2.11 Maximum number of florets per spike

The character maximum number of florets per spike exhibited of variation from 9.45 to 14.81 with a grand mean 12.45. The maximum number of florets per spike was recorded in genotype Arka Aayush (14.81) followed by dhanvan Lari (12.96), Jester (12.80) where minimum number of florets per spike recorded in Arka Pratham (9.45).

4.2.12 Maximum number of spikes per plant

The character maximum number of spikes exhibited of variation from 1.00 to 2.17 with a grand mean 1.86. The maximum number spike per plant was recorded in genotype Arka Aayush (2.17) followed by Punjab Lemon Delight (2.11), P.B.Clown (2.10) where minimum number of spikes per plant recorded in Arka Pratham (1.00).

4.2.13 Maximum Floret length

The character maximum floret length exhibited of variation from 8.94 to 11.85 with a grand mean 10.80. The maximum floret length was recorded in genotype Arka Aayush (11.85) followed by yellow stone (11.25), where minimum floret length Arka Pratham (8.94).

4.2.14 Maximum Floret Diameter

The character maximum floret Diameter exhibited of variation from 8.05 to 11.10 with a grand mean 9.90. The maximum Floret diameter was recorded in genotype was recorded in Arka Pratham (11.10) followed by Phule Neelrekha (11.00) where minimum floret

diameter Phule Ganesh (8.05).

4.2.15 Maximum number of corms produced per plant

The character maximum number of corms produced per plant exhibited of variation from 1.05 to 2.61 with a grand mean 1.84. The maximum number of corms produced per plant was recorded in genotype Arka Pratham (2.61) followed by Punjab Phame (2.60), where minimum number of corms produced/mother corm recorded in Red Genger (1.05).

4.2.16 Maximum corm diameter

The character maximum corm diameter exhibited of variation from 3.34 to 6.54 with a grand mean 5.58. The maximum number of corm diameter was recorded in genotype yellow stone (6.54) followed by Arka Pratham (6.46), where minimum corm diameter recorded in Arka Tilak (3.34)

4.2.17 Maximum weight corm(g)

The character maximum weight of corm exhibited of variation from 32.17 to 54.25 with a grand mean 43.36. The maximum weight of corm was recorded in genotype Arka Aayush (54.25) followed by P.S. Hybrid (50.74), Dhanvan Lari (50.25) where minimum weight of corm is Arka Pratham (32.17).

4.2.18 Maximum cormel diameter

The character cormel diameter exhibited of variation from 0.40 to 2.40 with a grand mean 1.85. The maximum cormel diameter was recorded in genotype Chandni (2.40) followed by Punjab Lemon Delight (2.30), Dhanvan Lari (2.13) where minimum cormel diameter recorded in Arka Pratham (0.40).

4.2.19 Maximum number of corms per hectare

The maximum number of corms per hectare exhibited of variation from 174999 to 434998 with a grand mean 286658. The maximum number of corms per hectare was recorded in genotype Arka Aayush (434998) followed by P.B. Clown (399998) ,Punjab Lemon Delight (389998) and minimum number of corms per hectare Arka Pratham (174999).

4.2.20 Maximum number of cormels per hectare

The maximum number of cormels per hectare exhibited of variation from 1856310 to 7147000 with a grand mean 4004533. The maximum number of cormels per hectare was recorded in Arka Aayush (7147000) followed by P.B.Clown (6195000) and minimum number of cormels recorded in Arka Pratham (1856310).

4.2.21 Maximum corm yield per plant (g)

The maximum corm yield per plant exhibited of variation from 35.94 to 156.60 with a grand mean 89.55. The maximum corm yield per plant was recorded in Arka Pratham (156.60) followed by P.B. Clown (130.02) ,Punjab Lemon Delight (123.22) and minimum number of yield per plant in Arka Pratham (35.94) and Arka Tilak (39.2).

Table 8. **Mean performance of 22 genotypes for growth, flowering and corms yield characters of Gladiolus (*Gladiolus grandiflorus L.*)**

Sl. No.	Genotypes	Plant height (30 days)	Plant height (60 days)	Plant height (90 days)	Number of leaves per plant at 30 DAS	Number of leaves per plant at 60 DAS	Number of leaves per plant at 90 DAS
1	SOUVIK BISCUITS	47.83	64.60	103.37	2.93	6.81	10.99
2	DHANVAN LARI	45.03	75.35	101.00	4.80	8.06	13.04
3	MANHITTAN	44.37	73.67	112.18	2.45	6.27	10.50
4	P.B. CLOWN	36.16	65.38	114.57	2.25	6.34	10.25
5	ARKA NAVEEN	40.18	69.09	102.37	3.47	7.37	11.56
6	JESTER	46.72	75.83	104.66	4.83	8.34	13.18
7	PUNJAB LEMON DELIGHT	50.47	81.13	114.93	2.20	5.74	9.96
8	URMI	41.58	70.38	106.83	2.27	6.12	10.34
9	ARKA PARTHAM	32.90	61.76	99.08	4.87	8.86	13.34
10	PRISCILLA	38.20	67.15	104.58	4.41	8.30	12.57
11	RED GINGER	41.78	70.73	104.47	3.42	7.25	11.52
12	ARKA TILAK	48.54	68.27	107.54	4.35	6.79	9.50
13	PHULE GANESH	42.45	64.52	104.47	4.25	7.16	9.73
14	ALY ANYQUE	44.62	76.01	111.00	2.05	5.34	9.25
15	CHANDANI	44.89	75.73	110.30	2.27	6.12	10.34

16	YELLOW STONE	45.79	69.50	114.83	4.62	8.57	12.79
17	PUNJAB FLAME	50.90	78.38	105.26	4.35	6.79	9.80
18	PUSA SUHAGIN	42.72	72.19	112.95	4.25	7.16	9.73
19	ARKA AAYUSH	52.56	83.60	118.57	4.07	8.80	12.34
20	P.S HYBRID	42.45	64.52	102.57	2.45	6.27	10.50
21	PHULE NEELREKHA	40.49	80.63	105.17	2.35	5.84	9.54
22	PUNAB BINK CHALNU	42.72	68.27	101.84	4.65	7.28	9.45
Mean		**47.17**	**72.68**	**106.65**	**3.90**	**7.27**	**10.12**
CV		**8.05**	**6.25**	**5.87**	**6.02**	**6.91**	**8.50**
SEm		**2.23**	**2.21**	**3.63**	**0.13**	**0.29**	**0.64**
CD at 5%		**4.89**	**6.24**	**10.03**	**0.34**	**0.83**	**1.46**
CD at 1%		**6.08**	**8.45**	**13.60**	**0.58**	**1.11**	**1.79**
Minimum		**32.90**	**61.76**	**99.08**	**2.05**	**5.34**	**9.25**
Maximum		**52.56**	**83.60**	**118.57**	**4.87**	**8.86**	**13.34**
Replication		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Treatment		**S**	**S**	**S**	**S**	**S**	**S**

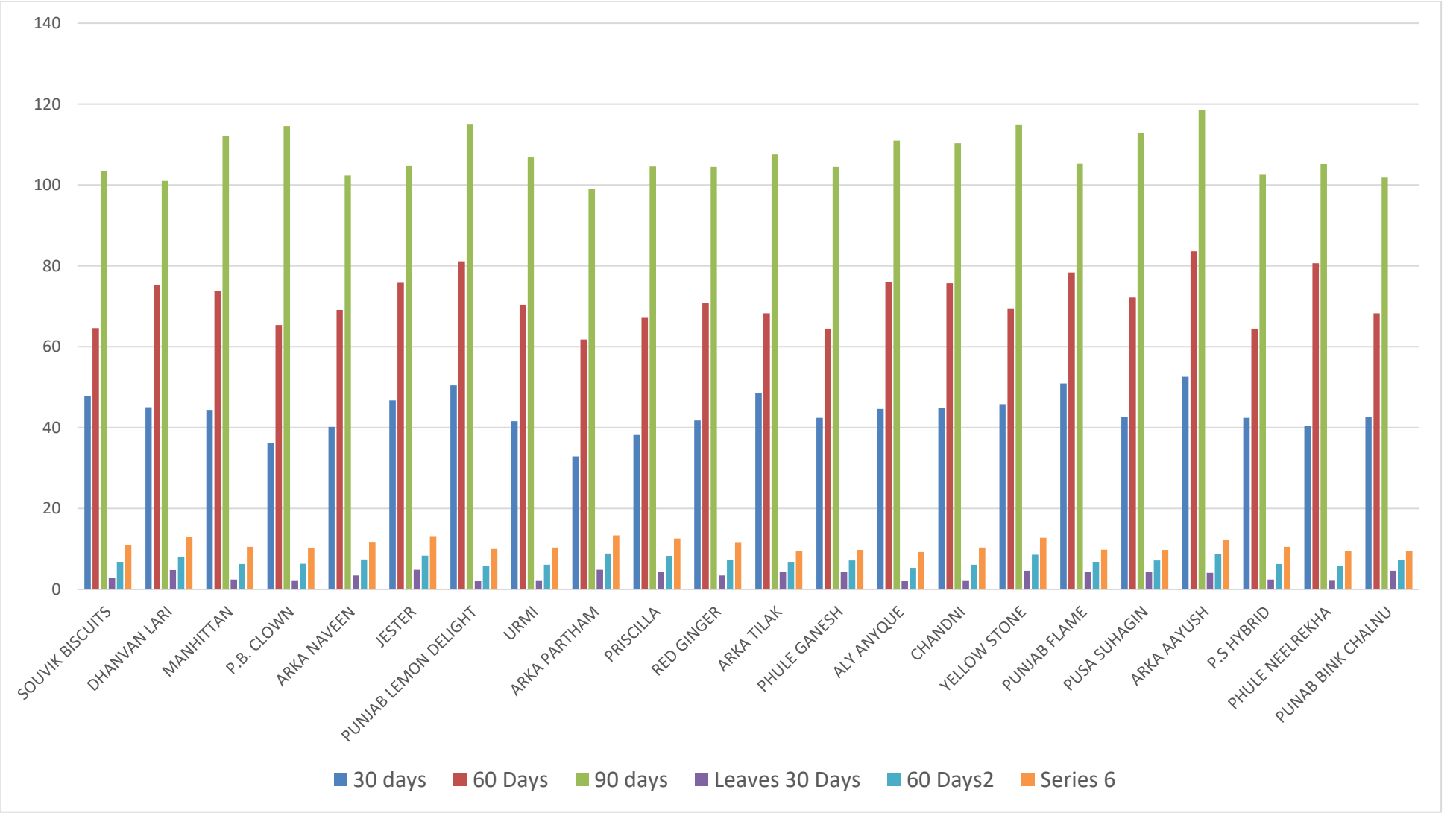

Fig 3: Mean performance of 22 genotypes for growth, flowering and corms yield characters of Gladiolus (*Gladiolus grandiflorus L.*)

Table 9. Mean performance of 22 genotypes for growth, flowering and corms yield characters of Gladiolus (*Gladiolus grandiflorus L.*)

Sl. No.	Genotypes	no. of shoot per plant	Days for 50% sprouting	Rachis length (cm)	Days for spike emergence	Days for colour of basal floret	No. of Floret Per Spike
1	SOUVIK BISCUITS	1.30	3.23	55.10	74.08	80.83	11.10
2	DHANVAN LARI	1.35	3.25	51.10	76.41	84.74	12.96
3	MANHITTAN	2.19	3.33	43.50	80.54	88.68	12.18
4	P.B.CLOWN	2.20	6.04	44.70	77.04	85.32	10.45
5	ARKA NAVEEN	1.38	5.01	41.19	79.69	88.27	11.75
6	JESTER	2.00	5.15	52.12	80.24	87.92	12.80
7	PUNJAB LEMON DELIGHT	1.52	4.83	46.99	81.25	89.79	11.45
8	URMI	1.71	4.93	42.35	82.02	92.00	12.59
9	ARKA PARTHAM	1.22	**6.64**	**38.64**	**83.22**	**92.64**	**9.45**
10	PRISCILLA	1.30	5.48	40.17	80.48	87.29	12.58
11	RED GINGER	1.35	5.08	51.57	72.64	78.75	10.42
12	ARKA TILAK	1.30	4.99	40.75	74.44	80.89	12.53
13	PHULE GANESH	1.75	5.80	45.69	71.44	78.37	10.96
14	ALY ANYQUE	1.90	4.65	43.94	80.27	81.49	11.34
15	CHANDANI	2.08	4.90	50.35	73.27	80.90	11.02

16	YELLOW STONE	1.29	5.96	49.09	76.99	84.14	10.40
17	PUNJAB FLAME	1.44	4.83	51.46	76.91	84.93	9.69
18	PUSA SUHAGIN	1.81	5.52	53.34	80.02	83.24	11.20
19	ARKA AAYUSH	**2.25**	3.16	**55.50**	**70.04**	78.37	**14.81**
20	P.S HYBRID	2.05	5.57	51.35	80.85	82.66	9.64
21	PHULE NEELREKHA	2.15	5.05	50.86	73.35	80.84	9.59
22	PUNAB BINK CHALNU	1.50	6.06	48.85	75.51	81.65	11.05
Mean		**1.76**	**5.80**	**47.64**	**75.56**	**85.60**	**12.45**
CV		**6.86**	**6.80**	**6.86**	**6.98**	**6.80**	**6.80**
SEm		**0.08**	**0.87**	**2.03**	**3.45**	**3.56**	**0.67**
CD at 5%		**0.27**	**0.76**	**5.90**	**4.86**	**9.05**	**1.65**
CD at 1%		**0.40**	**0.96**	**7.85**	**11.60**	**12.54**	**2.05**
Minimum		**1.22**	**3.16**	**38.64**	**70.04**	**78.37**	**9.45**
Maximum		**2.25**	**6.64**	**55.50**	**83.22**	**92.64**	**14.81**
Replication		**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Treatment		**S**	**S**	**S**	**S**	**S**	**S**

-

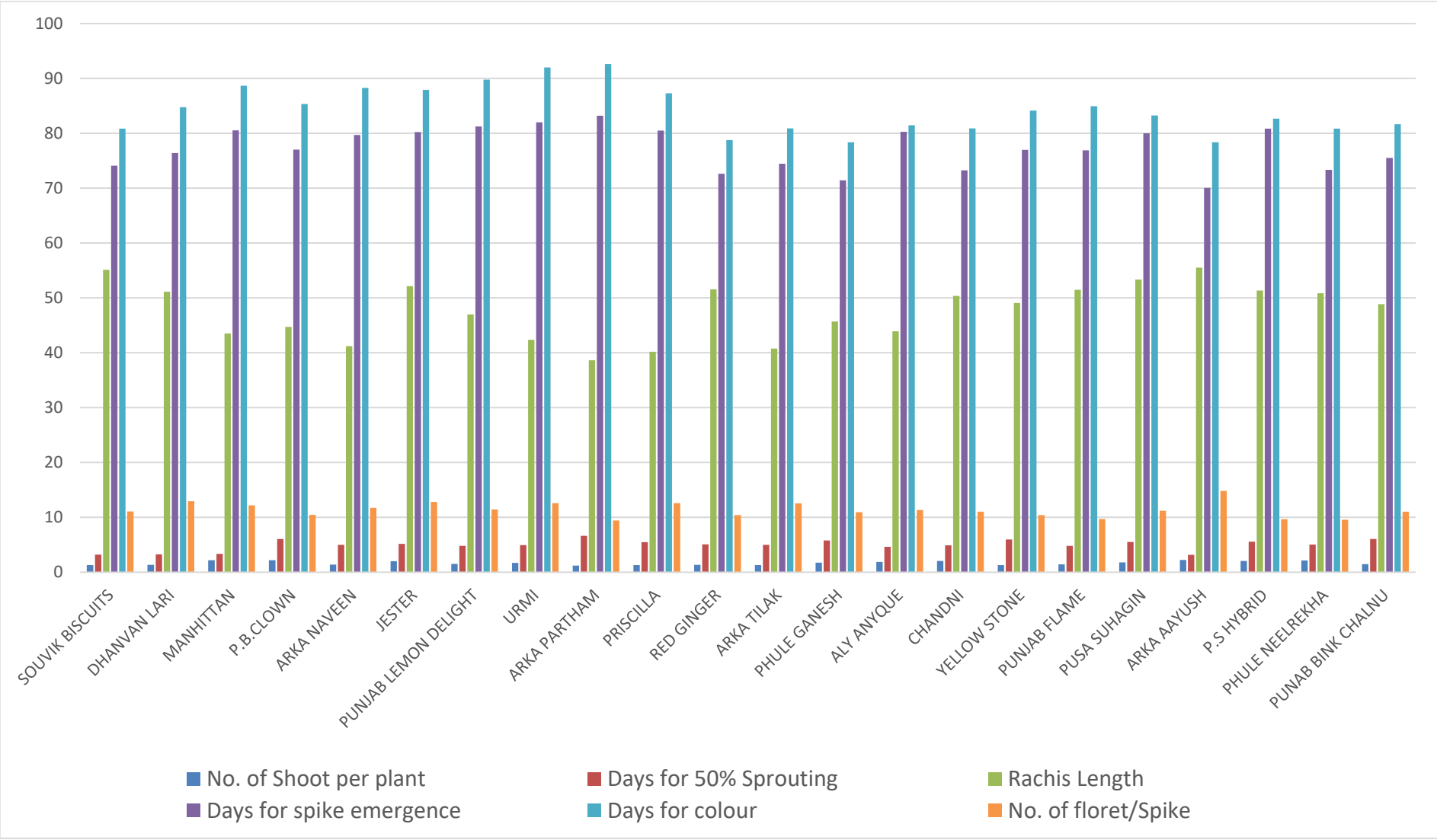

Fig 4: Mean performance of 11 genotypes for growth, flowering and corms yield characters of Gladiolus (*Gladiolus grandiflorus L.)*

4.3.1 Genotypic coefficient of variation (GCV)

The estimates of GCV from present investigation are presented in table 9. The genotypic coefficient variance value were categorized as low (0 -10%), moderate (10-20%) and high (20% and above) given by **Sivasubramanian and Madhavamenon (1973).** Wide range of genotypic coefficient of variation (GCV) was observed for the characters ranging from number of leaves at 30DAS (52.70) to days to show color of basal floret(4.34). High magnitude of GCV were recorded for Number of leaves (52.70), Corm yield/plant(46.40), Number of cormels/hectare(39.12), Cormel diameter(38.36), Number of corms/hectare(28.97), Number of corms per plant(28.97),Number of leaves at 60DAS(26.64), Number of shoot(26.64) .While as moderate estimate was observed for Days to first flowering (18.83), Corm diameter(18.64), Weight of corm(17.21),Rachis length (16.70), Plant height at 30DAS(12.00),Number of leaves at 90DAS (11.73), Number of florets per spike (11.61), Days taken 50% flowering(10.71),Floret diameter (10.35), Plant height at 60DAS(10.20). Whereas low estimates was observed for Floret length(8.95) , Plant height at 90DAS(6.85), Number of days for emergence of flower spike(5.54) , Days to show color of basal floret(4.34). Similar findings were also reported by Bhujbal *et al*., (2013), Blamuurugan *et al*., (2002), Kumar *et al*., (2011), Naresh *et al*., (2015), Panwar *et al*., (2013), Mishra (2008) and Pattanaik *et al*., (2013).

4.3.2 Phenotypic coefficient variation(PCV)

The estimates of PCV from present investigation are presented in table 9. The phenotypic coefficient variance value were categorized as low (0 -10%), moderate (10-20%) and high (20% and above) given by **Sivasubramanian and Madhavamenon (1973).** Wide range of phenotypic coefficient of variation (PCV) was observed for the characters ranging from number of leaves at 30DAS (52.92) to days to show color of basal floret(5.79). High magnitude of GCV were recorded for Number of leaves 30 (52.92), Corm yield/plant(46.61), Number of cormels/hectare(39.34), Cormel diameter(38.62) , Number of corms/hectare(29.30), Number of corms per plant(29.29),Number of leaves at 60DAS(27.00), Number of shoot(26.94) .While as moderate estimate was observed for Days to first flowering (19.20) , Corm diameter(18.99), Weight of corm(17.84),Rachis length (17.04), Plant height at 30DAS(12.70),Number of leaves at 90DAS (12.49), Number of florets per spike (12.20), Days taken 50% flowering(11.47),Floret diameter (11.02),

Plant height at 60DAS(10.89). Whereas low estimates was observed for Floret length(9.83) , Plant height 90DAS(8.00), Number of days for emergence of flower spike(6.76) , Days to show color of basal floret(5.79). Similar findings were also reported by Bhujbal *et al*., (2013), Blamuurugan *et al*., (2002), Kumar *et al*., (2011), Naresh *et al*., (2015), Panwar *et al*., (2013), Mishra (2008) and Pattanaik *et al*., (2013).

4.3.1 Heritability

The estimates of heritability from present investigation are presented in table 9. In the present study the heritability estimates in broad sense were classified into 3 groups such as high (>75%), moderate (60% - 75%), low (<60%).The heritability estimates were found to be high (more than 75%). The high heritability in broad sense was observed for the characters viz Corms yield/ plant (99.20), Number of leaves (99.10), Number of cormels/ hectare(99), Cormel diameter(98.62), Number of corms/plant(97.87), Number of shoot per plant(97.78), Number of leaves 60DAS(97.35), Number of spike per plant(97.03), Corm diameter(96.40) , Days to first flowering(96.21), Rachis length (96.11), Weight of corm(93.06), Number of florets per spike(90.57) , Plant height at 30DAS (89.28), Floret diameter(88.23), Number of leaves(88.23), Plant height at 60DAS (87.80), Floret length (82.90). While as moderate estimates was observed Plant height at 90DAS(73.32) , Number of days of emergence of flower spike(67.29), Days to show color of basal floret(56.29). [73] The present findings are in accordance with the findings of Anuradha and Gowda (1990), Sorianatha sundaram and Nambisan (1991), Mahanta and Paswan (1995), Sheikh *et al*., (1995), Balaram *et al*., (2000), Deepti (2000), Balamurugan *et al*., (2002), Bichoo *et al*., (2002), and Pratap and Rao (2006), Balaram and Janakiram (2009), Bhujbal *et al*.,(2013), Archana *et al*., (2008), Choudhary *et al*., (2012), Naresh *et al*., (2015), Singh *et al*., (2017) and Vanlalruati *et al*.,(2013).

4.3.2 Genetic advance

In the present investigation, the genetic advance estimates were found to be high for number of cormels/hectare (3208825), Number of corms/hectare (164828). Whereas moderate estimate observed for Rachis length (21.59), Weight of corm (15.20), Plant height at 60DAS (14.41) , Plant heigth at 90DAS(12.63), Plant height at 30DAS(11.41). Low estimates observed for Number of leaves 30DAS (7.61), Number of leaves 60DAS (5.63), Number of leaves at 90DAS (4.11).

4.3.3 Genetic advance % mean

In the present investigation, the genetic advance % mean estimates were found to be high for corm yield/plant(95.15), Number of cormels per hectare(80.13), Cormel diameter (78.46), Number of corms per plant(59.05). Whereas moderate genetic advance % mean Floret length (16.78), Plant height at 90DAS (12.08). Low estimates observed for number of days for emergence of flower spike (9.37), Days to show color of basal floret (6.71).

Table 10. Estimation of component of variance and genetic parameters for 23 character growth, flowering and corm yield of 15 genotypes in Gladiolus

Characters	Mean	Min	Man	var (g)	var (p)	Heritability (%)	GA	GA% mean	GCV (%)	PCV (%)
Plant height cm (30 days)	48.84	40.49	61.33	34.34	38.46	89.28	11.41	23.35	12.00	12.70
Plant height cm (60 days)	73.17	58.63	93.07	55.72	63.46	87.80	14.41	19.69	10.20	10.89
Plant height cm (90 days)	104.54	88.00	118.46	51.25	69.91	73.32	12.63	12.08	6.85	8.00
Number of leaves (30 das)	7.03	2.05	12.10	13.75	13.86	99.20	7.61	108.13	52.70	52.92
Number of leaves (60 das)	10.39	6.12	14.56	7.66	7.87	97.35	5.63	54.15	26.64	27.00
Number of leaves (90 das)	18.10	14.35	21.22	4.51	5.11	88.23	4.11	22.70	11.73	12.49
No. of shoot per plant	1.53	1.01	2.20	0.17	0.17	97.78	0.83	54.26	26.64	26.94
Days taken for 50% sprouting	6.21	5.00	7.32	0.44	0.51	87.10	1.28	20.58	10.71	11.47
Days to first flowering	13.59	9.63	18.00	6.55	6.81	96.21	5.17	38.05	18.83	19.20
Rachis length (cm)	64.02	48.99	80.25	114.34	118.96	96.11	21.59	33.73	16.70	17.04
No. Of days for emergence of flower spike	77.91	67.47	83.22	18.64	27.71	67.29	7.30	9.37	5.54	6.76
days to show colour of basal floret	86.57	78.32	92.65	14.14	25.11	56.29	5.81	6.71	4.34	5.79
No. Of florets per spike	14.26	10.78	17.06	2.74	3.03	90.57	3.25	22.75	11.61	12.20
Number of spikes per plant	1.48	1.00	2.17	0.15	0.16	97.03	0.80	53.72	26.47	26.87
Floret length	10.24	8.94	11.85	0.84	1.01	82.90	1.72	16.78	8.95	9.83
Floret diameter	9.44	8.05	10.91	0.95	1.08	88.23	1.89	20.03	10.35	11.02
No. of corms per plant	1.68	1.05	2.61	0.24	0.24	97.87	0.99	59.05	28.97	29.29
Corm diamter cm	5.29	3.34	6.46	0.97	1.01	96.40	2.00	37.71	18.64	18.99
Weight of corm(gm)	44.43	34.23	60.00	58.50	62.86	93.06	15.20	34.21	17.21	17.84
Cormel diameter(cm)	1.51	0.40	2.40	0.34	0.34	98.62	1.19	78.46	38.36	38.62
No. Of corms / hectare	279332	174999	434998	6548146153	6697406742	98	164828	59.01	28.97	29.30
Number of cormels /hectare	4004533	1856310	7147000	2453812976576	2481562436637	99	3208825	80.13	39.12	39.34
Corms yield/plant(g)	77.91	35.94	156.60	1307	1319	99.10	74.13	95.15	46.40	46.61

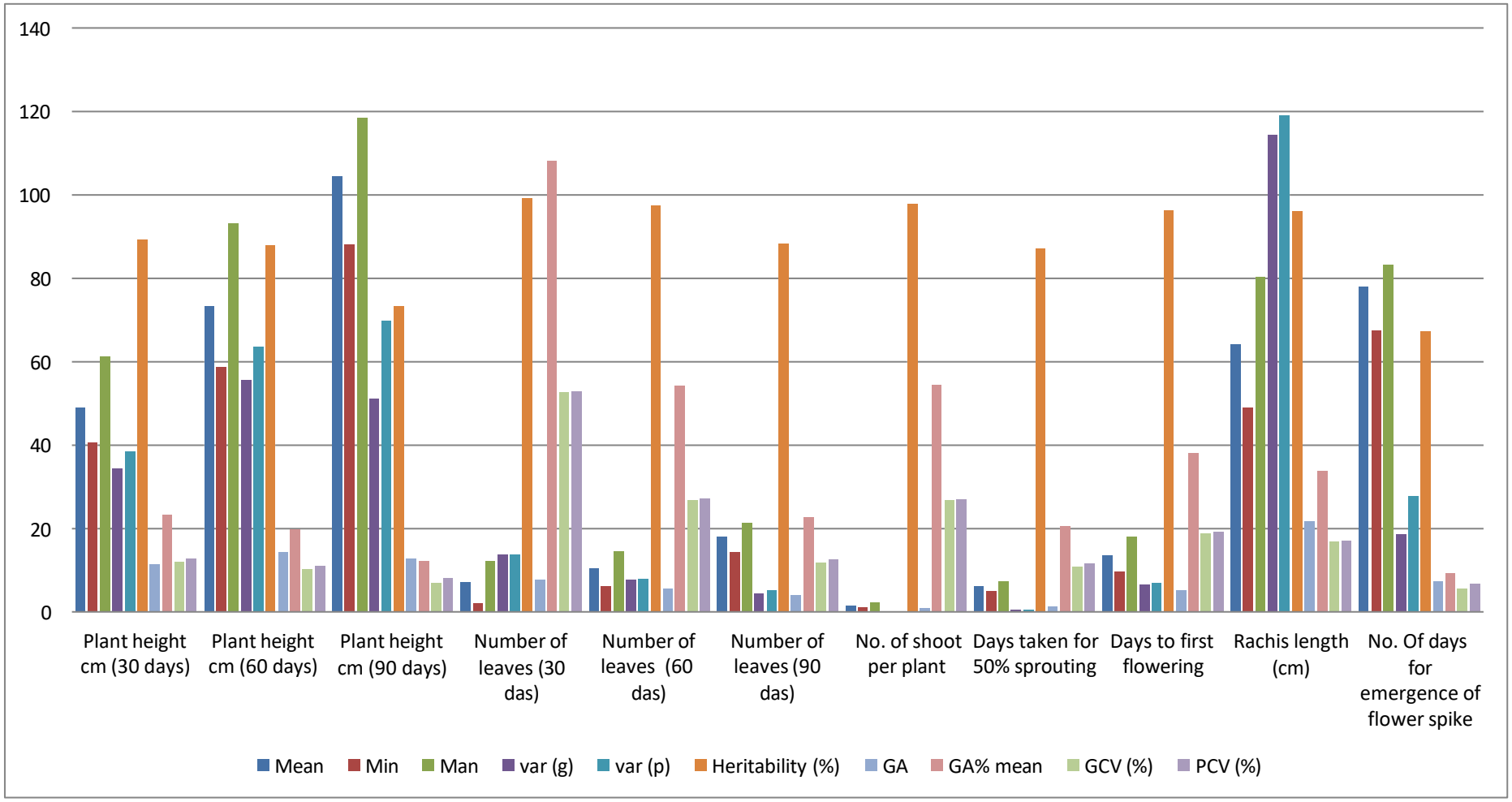

Fig. 5: Estimation of component of variance and genetic parameters for 23 character growth, flowering and corm yield characters of 15 genotypes in Gladiolus.

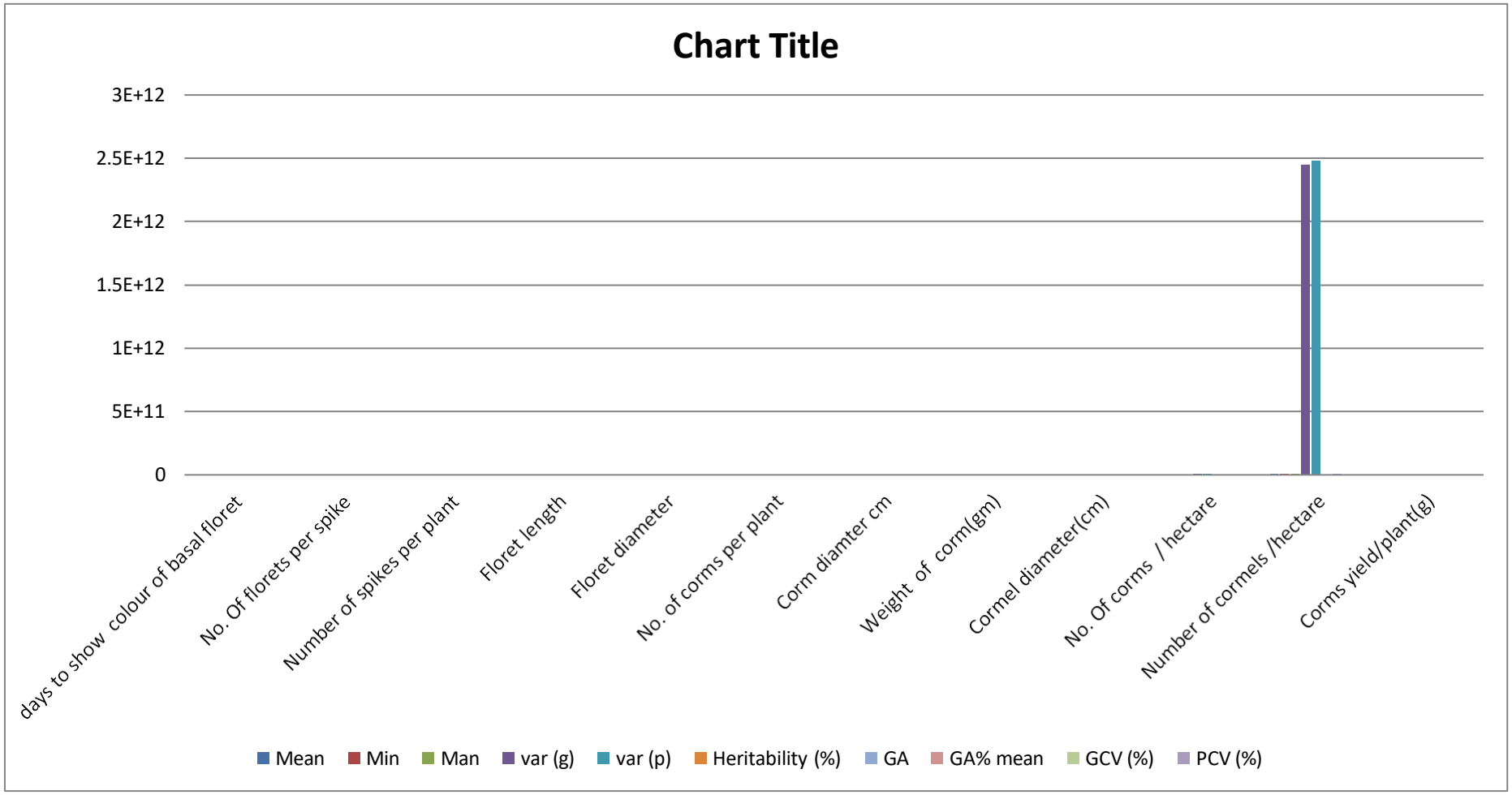

Fig. 6: Estimation of component of variance and genetic parameters for 23 character growth, flowering and corm yield characters of 15 genotypes in Gladiolus.

4.4 Correlation coefficient

Correlation coefficient is a statistical measure which is used to find out the degree (strength) and direction of relationship between two or more variables. A positive value of correlation shows that the changes of two variables are in the same directions. In the present investigation correlation coefficient analysis measure the mutual relationship between various plant characters and to determine the component character on which selection can be used for genetic improvement in yield while selecting the suitable plant type, correlation studies would provide reliable information in nature of extent and the direction of the selection especially when the breeder needs to combine high yield potential with desirable traits. In this study the genotypic and phenotypic correlation coefficient of different characters with Corms yield/plant (g) and their relationship among themselves are presented in table 10 and are discussed here under following points.

4.4.1 Correlation coefficient at genotypic level

Genotypic correlation coefficient analysis revealed that Corms yield/plant (g) showed positive significant association with Number of leaves at 30DAS (0.897**), Number of leaves at 60DAS (0.893**), Number of leaves 90DAS (0.852**), Number of shoot per plant (0.918**), Days to first flowering (0.854**), Rachis length (0.860**), No. Of florets per spike (0.638**), Number of spikes per plant (0.923**), Floret length (0.950**) ,Floret diameter (0.872**), No. of corms per plant (0.998**), Corm diameter (0.819**), Weight of corm (0.994**), Number of corms per hectare (0.995**), Number of cormels per hectare (0.990**).

- **Plant height(cm) at 30DAS**

Plant height(cm) at 30DAS showed positive significant association with plant height at 60DAS (0.548**), Plant height at 90DAS(0.497**) ,

- **Plant height (cm) at 60DAS**

Plant height (cm)at 60DAS showed positive significant association with Plant height(cm) at 90DAS(0.821**).

- **No. of leaves at 30DAS**

It shows positive association with No. of leaves at 60DAS (0.994**), No. of leaves at

90DAS (0.998**), No. of shoot at per plant (0.967**), Days to first flowering (0.932**), Rachis length (0.937**), No. of florets per spike (0.691**), Number of spike per plant (0.960**), Floret length (cm) (0.975**), Floret diameter (0.977*), Number of corms per plant(0.913**), Corm diameter(0.734**), weight of corm(0.899**), Number of corms per hectare(0.917**), Number of cormels per hectare(0.881**), Corms yield per plant(0.897**).

- **No. of leaves at 60DAS**

It shows positive association with No. of leaves at 90DAS(0.925**),No. of shoot per plant(0.982**),Days to first flowering(0.952**), Rachis length(0.953), No. of florets per spike(0.690**), Number of spike per plant (0.950**), Floret length(0.881**), Floret diameter(0.923*), Number of corms per plant(0.872**), Corm diameter(0.653**), weight of corm(0.829**), Number of corms per hectare(0.883**), Number of cormels per hectare(0.849**), Corms yield per plant(0.876**).

- **No. of leaves at 90 DAS**

No. of shoot per plant(0.890**),Days to first flowering(0.900**) Rachis length(0.893**) , No. of florets per spike(0.625**), Number of spike per plant (0.893**), Floret length(0.822**), Floret diameter(0.827*), Number of corms per plant(0.830**), Corm diameter(0.596**), weight of corm(0.780**), Number of corms per hectare(0.812**), Number of cormels per hectare(0.769**), Corms yield per plant(0.799**).

- **No. of shoot per plant**

It shows positive association with days to first flowering(0.936**), Rachis length(0.932**), No. of florets per spike(0.741**), Number of spike per plant (0.977**), Floret length(0.889**), Floret diameter(0.887*), Number of corms per plant(0.900**), Corm diameter(0.682**), weight of corm(0.828**), Number of corms per hectare(0.898**), Number of cormels per hectare(0.892**), Corms yield per plant(0.898**).

- **Days taken for 50% sprouting**

It shows positive association with No. of days for emergence of flower spike (0.572**), Days to show color of basal floret (0.484**),

- **Days to first flowering**

It shows positive association with shows positive association with Rachis length (0.967**), No. of florets per spike (0.773**), Number of spike per plant (0.949**), Floret length(0.917**), Floret diameter (0.945**), Number of corms per plant(0.859**), Corm diameter(0.687**), weight of corm (0.847**), Number of corms per hectare(0.863**), Number of cormels per hectare(0.837**), Corms yield per plant(0.854**).

- **Rachis length**

It shows positive association with No. of florets per spike (0.656**), Number of spike per plant (0.967**), Floret length (0.893**), Floret diameter (0.867**), Number of corms per plant (0.865**), Corm diameter (0.608**), weight of corm (0.848**), Number of corms per hectare (0.859**), Number of cormels per hectare (0.831**), Corms yield per plant (0.860**).

- **Number of days for emergence of flower spike**

It shows positive association with Days to show color of basal floret (0.755**),

- **No. of florets per spike**

It shows positive association with Number of spike per plant (0.760**), Floret length (0.815**), Floret diameter (0.822**), Number of corms per plant (0.651**), Corm diameter (0.484**), weight of corm (0.574**), Corms yield per plant (0.638**).

- **No. of spikes per plant**

It shows positive association with number od spikes per plant (0.760**), floret length (0.815**), floret diameter (0.822**), no. of corms per plant (0.651**), corm diameter (0.484**), weight of corm (0.574**), no. corms per hectare (0.649**), no. of cormels per hectare (0.656**), corms yield per plant (0.638**).

- **Floret length**

It shows positive association with Floret diameter(0.912**), Number of corms per plant(0.968**), Corm diameter(0.777**), weight of corm(0.941**),Number of corms per hectare(0.966**),Number of cormels per hectare(0.929**),Corms yield per plant(0.950**).

- **Floret diameter**

It shows positive association with Number of corms per plant (0.911**), Corm diameter(0.816**), weight of corm(0.883**), Number of corms per hectare(0.899**), Number of cormels per hectare(0.884**), Corms yield per plant(0.872**).

Number of corms per plant

It shows positive association with Corm diameter (0.855**), weight of corm (0.994**), Number of cormels per hectare (0.996**), Corms yield per plant (0.998**).

- **Corm diameter**

It shows positive association with weight of corm (0.877**), Number of corms per hectare (0.856**), Number of cormels per hectare (0.841**), Corms yield per plant (0.819**).

- **Weight of corm**

It shows positive association with Number of corms per hectare (0.992**), No. of cormels per hectar(0.991**),Yield of corm/Plant(0.994**).

- **No. of corm/ha**

It shows positive association with Number of cormels per hectare (0.981**), Yield of corm per plant (0.995**).

- **Number of cormels per hectare**

It shows positive association with Yield of corm per plant (0.990**).

4.4.2 Correlation coefficient at phenotypic level

Phenotypic correlation coefficient analysis revealed that Corms yield/plant (g)

showed positive significant association Number of leaves at 30DAS(0.885**), Number of leaves at 60DAS(0.876**), Number of leaves90DAS(0.799**), Number of shoot per plant(0.898**), Days to first flowering(0.826**), Rachis length(0.835**), No. Of florets per spike(0.597**) ,Number of spikes per plant(0.915**), Floret length(0.852**) ,Floret diameter(0.819**), No. of corms per plant(0.985**), Corm diameter(0.800**), Weight of corm(0.969**),Number of corms per hectare(0.990**), Number of cormels per hectare(0.972**).

- **Plant height (cm) at 30DAS**

Plant height (cm) at 30DAS showed positive significant association with plant height at60DAS (0.404**), Plant height at 90DAS (0.501**) .

- **Plant height (cm) at 60DAS**

Plant height at 60DAS showed positive significant association with Plant height (cm) at 90DAS (0.529**).

- **No. of leaves at 30DAS**

It shows positive association with No. of leaves at 60DAS (0.971**), No. of leaves at 90DAS (0.931**), No. of shoot at per plant(0.951**), Days to first flowering(0.911**), Rachis length(0.914**), No. of florets per spike(0.668**), Number of spike per plant (0.931**), Floret length(0.892**), Floret diameter(0.916*), Number of corms per plant(0.901**), Corm diameter(0.723**), weight of corm(0.862**), Number of corms per hectare(0.895**), Number of cormels per hectare(0.875**), Corms yield per plant(0.885**).

- **No. of leaves at 60DAS**

It shows positive association with No. of leaves at 90DAS(0.917**),No. of shoot per plant(0.964**),Days to first flowering(0.932**), Rachis length(0.929**), No. of florets per spike(0.690**), Number of spike per plant (0.950**), Floret length(0.881**), Floret diameter(0.923**), Number of corms per plant(0.872**), Corm diameter(0.653**), weight of corm(0.829**), Number of corms per hectare(0.883**), Number of cormels per hectare(0.849**), Corms yield per plant(0.876**).

- **No. of leaves at 90 DAS**

No. of shoot per plant(0.890**),Days to first flowering(0.900**) Rachis length(0.893**) , No. of florets per spike(0.625**), Number of spike per plant (0.893**), Floret length(0.822**), Floret diameter(0.827*), Number of corms per plant(0.830**), Corm diameter(0.596**), weight of corm(0.780**), Number of corms per hectare(0.812**), Number of cormels per hectare(0.769**), Corms yield per plant(0.799**).

- **No. of shoot per plant**

It shows positive association with days to first flowering(0.936**), Rachis length(0.932**), No. of florets per spike(0.741**), Number of spike per plant (0.977**), Floret length(0.889**), Floret diameter(0.887*), Number of corms per plant(0.900**), Corm diameter(0.682**), weight of corm(0.828**), Number of corms per hectare(0.898**), Number of cormels per hectare(0.892**), Corms yield per plant(0.898**).

- **Days taken for 50% sprouting**

It shows positive association with No. of days for emergence of flower spike (0.572**), Days to show color of basal floret (0.484**),

- **Days to first flowering**

It shows positive association with shows positive association with Rachis length (0.929**), No. of florets per spike(0.773**), Number of spike per plant (0.949**), Floret length(0.917**), Floret diameter(0.945**), Number of corms per plant(0.859**), Corm diameter(0.687**), weight of corm(0.847**), Number of corms per hectare(0.863**), Number of cormels per hectare(0.837**), Corms yield per plant(0.854**).

- **Rachis length**

It shows positive association with No. of florets per spike (0.622**), Number of spike per plant (0.918**), Floret length (0.812**), Floret diameter(0.822**), Number of corms per plant(0.827**), Corm diameter(0.585**), weight of corm(0.777**), Number of corms per hectare(0.838**), Number of cormels per hectare(0.808**), Corms yield per plant(0.835**).

- **Number of days for emergence of flower spike**

It shows positive association with Days to show color of basal floret (0.601**).

- **No. of florets per spike**

It shows positive association with Number of spike per plant (0.704**), Floret length (0.707**), Floret diameter (0.737**), Number of corms per plant (0.594**), Corm diameter (0.474**), weight of corm(0.529**) Number of cormels per hectare (0.621**)
,Number of corms per hectare (0.598*),Corms yield per plant(0.597**).

- **Number of spike per plant**

It shows positive association with Floret length (0.873**), Floret diameter (0.858**), Number of corms per plant (0.910**), Corm diameter (0.640**), Weight of corm (0.858**), Number f corms per hectare (0.919**), Number of cormels per hectare (0.890**), Corms yield pee plant (0.915**).

- **Floret length**

It shows positive association with Floret diameter(0.856**), Number of corms per plant(0.862**), Corm diameter(0.713**), weight of corm(0.769 **),Number of corms per hectare(0.865**),Number of cormels per hectare(0.854**),Corms yield per plant(0.852**).

- **Floret diameter**

It shows positive association with Number of corms per plant (0.828**), Corm diameter(0.740**), weight of corm(0.781**), Number of corms per hectare(0.849**), Number of cormels per hectare(0.822**), Corms yield per plant(0.819**).

- **Number of corms per plant**

It shows positive association with Corm diameter(0.824**), weight of corm(0.960**), Number of cormels per hectare(0.981**), Number of corms per hectare(0.985**), Corms yield per plant(0.985**).

- **Corm diameter**

It shows positive association with weight of corm (0.824**), Number of corms per hectare(0.821**),Number of cormels per hectare(0.819**), Corms yield per plant(0.800**).

- **Weight of corm**

It shows positive association with Number of corms per hectare (0.963**), No. of cormels per hectar(0.936**),Yield of corm/Plant(0.969**).

- **No. of corm/ha**

It shows positive association with Number of cormels per hectare (0.972**), Yield of corm per plant(0.990**).

- **Number of cormels per hectare**

It shows positive association with Yield of corm per plant (0.972**).

Table 11 Estimates of genotypic correlation coefficient for 23 Growth characters, Spike yield and vase life with Corms yield/plant (g)

Character	Plant height cm (30 days)	Plant height cm (60 days)	Plant height cm (90 days)	Number of leaves (30 das)	Number of leaves (60 das)	Number of leaves (90 das)	No. of shoot per plant	Days taken for 50% sprouting	Days to first flowering	Rachis length (cm)	No. Of days for emergence of flower spike	days to show colour of basal floret
	1	2	3	4	5	6	7	8	9	10	11	12
Plant height cm (30 days)	1.000	0.548**	0.497**	0.176	0.152	0.204	0.174	-0.214	0.278	0.219	-0.312*	-0.687**
Plant height cm (60 days)			0.821**	0.143	0.174	0.201	0.136	-0.193	0.156	0.066	-0.298*	-0.235
Plant height cm (90 days)				-0.032	0.039	0.075	-0.005	-0.035	0.120	0.050	-0.076	-0.273
Number of leaves (30 das)					0.994**	0.998**	0.967**	-0.906**	0.932**	0.937**	-0.676**	-0.719**
Number of leaves (60 das)						0.925**	0.982**	-0.935**	0.952**	0.953**	-0.731**	-0.713**
Number of leaves (90 das)							0.991**	-0.951**	0.989**	0.969**	-0.716**	-0.789**
No. of shoot per plant								-0.934**	0.956**	0.956**	-0.765**	-0.713**
Days taken for 50% sprouting									-0.906**	-0.863**	0.652**	0.660**
Days to first flowering										0.967**	-0.838**	-0.778**
Rachis length (cm)											-0.781**	-0.806**
No. Of days for emergence of flower spike												0.755**
days to show colour of basal floret												
No. Of florets per spike												
Number of spikes per plant												
Floret length												
Floret diameter												
No. of corms per plant												
Corm diamter cm												
Weight of corm(gm)												
Cormel diameter(cm)												

No. Of corms / hectare												
Number of cormels /hectare												
Corms yield/plant(g)												

Table 12 Estimates of genotypic correlation coefficient for 23 Growth characters, Spike yield and vase life with Corms yield/plant (g)

Character	No. Of florets per spike	Number of spikes per plant	Floret length	Floret diamter	No. of corms per plant	Corm diamter cm	Weight of corm (gm)	Cormel diameter (cm)	No. Of corms / hectare	Number of cormels /hectare	Corms yield/plant (g)
	13	14	15	16	17	18	19	20	21	22	23
Plant height cm (30 days)	0.379*	0.126	0.177	0.239	0.031	0.157	0.000	0.187	0.012	0.023	0.002
Plant height cm (60 days)	0.376*	0.127	0.277	0.303*	0.002	0.146	-0.026	0.324*	0.020	-0.044	-0.003
Plant height cm (90 days)	0.357*	-0.045	0.033	0.048	-0.212	-0.153	-0.234	0.334*	-0.227	-0.239	-0.212
Number of leaves (30 das)	0.691**	0.960**	0.975**	0.977**	0.913**	0.734**	0.899**	-0.001	0.917**	0.881**	0.897**
Number of leaves (60 das)	0.754**	0.977**	0.992**	0.964**	0.907**	0.677**	0.883**	-0.016	0.902**	0.868**	0.893**
Number of leaves (90 das)	0.748**	0.966**	0.971**	1.000**	0.852**	0.675**	0.833**	0.029	0.862**	0.826**	0.852**
No. of shoot per plant	0.771**	1.006**	0.988**	0.958**	0.930**	0.689**	0.891**	0.051	0.931**	0.900**	0.918**
Days taken for 50% sprouting	-0.833**	-0.934**	-0.978**	-0.950**	-0.881**	-0.669**	-0.834**	0.015	-0.887**	-0.855**	-0.865**
Days to first flowering	0.773**	0.949**	0.917**	0.945**	0.859**	0.687**	0.847**	0.068	0.863**	0.837**	0.854**
Rachis length (cm)	0.656**	0.967**	0.893**	0.867**	0.865**	0.608**	0.848**	-0.029	0.859**	0.831**	0.860**
No. Of days for emergence of flower spike	-0.766**	-0.761**	-0.688**	-0.744**	-0.646**	-0.391**	-0.617**	0.042	-0.628**	-0.685**	-0.654**
days to show colour of basal floret	-0.641**	-0.735**	-0.716**	-0.670**	-0.633**	-0.429**	-0.633**	0.232	-0.627**	-0.603**	-0.649**
No. Of florets per spike		0.760**	0.815**	0.822**	0.651**	0.484**	0.574**	0.300*	0.649**	0.656**	0.638**
Number of spikes per plant			0.993**	0.936**	0.933**	0.674**	0.878**	0.016	0.928**	0.913**	0.923**
Floret length				0.912**	0.968**	0.777**	0.941**	-0.028	0.966**	0.929**	0.950**
Floret diameter					0.911**	0.816**	0.883**	0.135	0.899**	0.884**	0.872**
No. of corms per plant						0.855**	0.994**	-0.136	1.008**	0.996**	0.998**
Corm diamter cm							0.877**	0.019	0.856**	0.841**	0.819**

Weight of corm(gm)								-0.234	0.992**	0.991**	0.994**
Cormel diameter(cm)									-0.135	-0.109	-0.206
No. Of corms / hectare										0.981**	0.995**
Number of cormels /hectare											0.990**
Corms yield/plant(g)											1.000

Table 13.Estimates of Phenotypic correlation coefficient for 23 Growth characters, Spike yield and vase life with Corms yield/plant (g)

Character	Plant height cm (30 days)	Plant height cm (60 days)	Plant height cm (90 days)	Number of leaves (30 das)	Number of leaves (60 das)	Number of leaves (90 das)	No. of shoot per plant	Days taken for 50% sprouting	Days to first flowering	Rachis length (cm)	No. Of days for emergence of flower spike	days to show colour of basal floret
	1	2	3	4	5	6	7	8	9	10	11	12
Plant height cm (30 days)	1.000	0.404**	0.501**	0.148	0.147	0.202	0.145	-0.181	0.229	0.230	-0.328*	-0.445**
Plant height cm (60 days)			0.529**	0.147	0.151	0.178	0.139	-0.202	0.165	0.045	-0.131	-0.271
Plant height cm (90 days)				-0.051	0.031	0.057	-0.014	-0.021	0.062	0.037	-0.159	0.067
Number of leaves (30 das)					0.971**	0.931**	0.951**	-0.838**	0.911**	0.914**	-0.548**	-0.560**
Number of leaves (60 das)						0.917**	0.964**	-0.863**	0.932**	0.929**	-0.576**	-0.563**
Number of leaves (90 das)							0.890**	-0.815**	0.900**	0.893**	-0.556**	-0.483**
No. of shoot per plant								-0.880**	0.936**	0.932**	-0.599**	-0.539**
Days taken for 50% sprouting									-0.858**	-0.782**	0.572**	0.484**
Days to first flowering										0.929**	-0.647**	-0.572**
Rachis length (cm)											-0.637**	-0.617**
No. Of days for emergence of flower spike												0.601**
days to show colour of basal floret												1.000
No. Of florets per spike												
Number of spikes per plant												
Floret length												
Floret diameter												
No. of corms per plant												
Corm diamter cm												
Weight of corm(gm)												

Cormel diameter(cm)												
No. Of corms / hectare												
Number of cormels /hectare												
Corms yield/plant(g)												

Table 14.Estimates of Phenotypic correlation coefficient for 23 Growth characters, Spike yield and vase life with Corms yield/plant (g)

Character	No. Of florets per spike	Number of spikes per plant	Floret length	Floret diameter	No. of corms per plant	Corm diamter cm	Weight of corm (gm)	Cormel diameter (cm)	No. Of corms / hectare	Number of cormels /hectare	Corms yield/plant (g)
	13	14	15	16	17	18	19	20	21	22	23
Plant height cm (30 days)	0.323*	0.142	0.150	0.243	0.024	0.129	0.022	0.161	0.058	-0.001	0.021
Plant height cm (60 days)	0.332*	0.100	0.277	0.259	0.015	0.126	-0.062	0.312*	-0.018	-0.006	-0.027
Plant height cm (90 days)	0.253	-0.007	-0.014	0.052	-0.174	-0.112	-0.158	0.259	-0.148	-0.240	-0.137
Number of leaves (30 das)	0.668**	0.931**	0.892**	0.916**	0.901**	0.723**	0.862**	-0.001	0.895**	0.875**	0.885**
Number of leaves (60 das)	0.690**	0.950**	0.881**	0.923**	0.872**	0.653**	0.829**	-0.007	0.883**	0.849**	0.876**
Number of leaves (90 das)	0.625**	0.893**	0.822**	0.827**	0.830**	0.596**	0.780**	0.019	0.812**	0.769**	0.799**
No. of shoot per plant	0.741**	0.977**	0.889**	0.887**	0.900**	0.682**	0.828**	0.055	0.898**	0.892**	0.898**
Days taken for 50% sprouting	-0.733**	-0.862**	-0.874**	-0.838**	-0.822**	-0.631**	-0.710**	-0.005	-0.812**	-0.803**	-0.802**
Days to first flowering	0.719**	0.910**	0.823**	0.876**	0.831**	0.655**	0.771**	0.079	0.824**	0.823**	0.826**
Rachis length (cm)	0.622**	0.918**	0.812**	0.822**	0.827**	0.585**	0.777**	-0.031	0.838**	0.808**	0.835**
No. Of days for emergence of flower spike	-0.617**	-0.626**	-0.635**	-0.547**	-0.518**	-0.364*	-0.503**	0.018	-0.547**	-0.528**	-0.558**
days to show colour of basal floret	-0.500**	-0.518**	-0.539**	-0.564**	-0.438**	-0.318*	-0.433**	0.151	-0.447**	-0.479**	-0.447**
No. Of florets per spike		0.704**	0.707**	0.737**	0.594**	0.474**	0.529**	0.276	0.598**	0.621**	0.597**
Number of spikes per plant			0.873**	0.858**	0.910**	0.640**	0.858**	0.013	0.919**	0.890**	0.915**
Floret length				0.856**	0.862**	0.713**	0.769**	-0.004	0.865**	0.854**	0.852**
Floret diameter					0.828**	0.740**	0.781**	0.116	0.849**	0.822**	0.819**
No. of corms per plant						0.824**	0.960**	-0.138	0.985**	0.981**	0.985**
Corm diamter cm							0.824**	0.024	0.821**	0.819**	0.800**
Weight of corm(gm)								-0.237	0.963**	0.936**	0.969**
Cormel diameter(cm)									-0.139	-0.104	-0.208
No. Of corms / hectare										0.972**	0.990**
Number of cormels /hectare											0.972**
Corms yield/plant(g)											1.000

SUMMARY AND CONCLUSION

The present investigation entitled "Study of Evaluating Genetic Variability of Gladiolus cultivar under Prayagraj Agro-climatic condition." was carried out with the objective to collect the basic information on genetic variation, heritability, genetic advance for twenty three quantitative characters for growth, flowering and corm yield.

The experimental materials of the present investigation primarily comprised of 15 genotypes of gladiolus during winter season 2022 in randomized block design with three replications at the experimental plot is located at Department of Horticulture, SHUATS, Prayagraj, U.P.

The observations were recorded on five randomly selected plants in each replication and data were used for statistical analysis. The summary and salient features of experimental findings are summarized below.

The mean performance for 15 genotypes revealed high values for number of cormel per hectare ranged from 1856310 to 7147000. The highest Number of cormels per hectare of genotype Yellow stone followed by Pusa suhagan.

The perusal of mean performance for Number of corms per hectare ranged from 174999 to 434998. The maximum number of corms per hectare was recorded in genotype Yellow stone followed by ,Pusa suhagin.

The perusal of mean performance Plant height at 90DAS ranged from 88 to 118.46.The highest plant height at 90DAS of genotype observed in Yellow stone followed by Pusa suhagan .

The perusal of mean performance for corm yield/plant 39.2 to 156.2.The maximum corm yield per plant was recorded in Yellow stone followed by,Pusa suhagan.

The perusal of mean performance for days to show color of basal floret 78.32 to 92.65.The maximum no. of days to show colour of basal floret was recorded in Chandni followed by ,Sovic biscuits , Pusa suhagan where minimum number of days show colour of basal floret Yellow stone (78.32).High mean and wide range for these traits suggest the presence of sufficient variability in the population for development of improved genotypes.

From the study of variability parameters , the magnitude of PCV was found to be greater than GCV , which suggest effect of environment on the expression of the traits studied . High estimates of PCV and GCV was recorded for Number of leaves 30DAS(52.70 and 52.92), Corm yield/plant(39.12 and 46.61), and least estimate for PCV and GCV was observed for Days to show color of basal floret (5.79 and 4.34) ,Number of cormels/hectare (39.12 and 39.34), Cormel diameter (38.36 and 38.62),Number of corms/hectare(28.97 and 29.30), Number of corms per plant(28.97 and 29.29),Number of leaves at 60DAS(26.64 and 27.00), Number of shoot(26.64 and 26.94) .

The high heritability in broad sense was observed for the characters viz Corms yield/ plant (99.20), Number of leaves (99.10), Number of cormels/ hectare(99), Cormel diameter(98.62), Number of corms/plant(97.87), Number of shoot per plant(97.78), Number of leaves 60DAS(97.35), Number of spike per plant(97.03), Corm diameter(96.40) , Days to first flowering(96.21), Rachis length (96.11), Weight of corm(93.06), Number of florets per spike(90.57) , Plant height at 30DAS (89.28), Floret diameter(88.23), Number of leaves(88.23), Plant height at 60DAS (87.80), Floret length (82.90). While as moderate estimates was observed Plant height at 90DAS(73.32) , Number of days of emergence of flower spike(67.29), Days to show color of basal floret(56.29).

Analysis of variance revealed significant differences for most of the traits under study implying that there is substantial variability among the 15 genotypes and thereby ample scope of selection of promising lines of Gladious .Significant differences were also observed for Number of corms per hectare, Number of cormels per hectare, Plant height at 30DAS , Rachis length ,Plant height at 60DAS.

Genotypic correlation coefficient analysis revealed that Corms yield/plant (g)

showed positive significant association with Number of leaves at 30DAS(0.897**), Number of leaves at 60DAS(0.893**), Number of leaves90DAS(0.852**), Number of shoot per plant(0.918**), Days to first flowering(0.854**), Rachis length(0.860**), No. Of florets per spike(0.638**) ,Number of spikes per plant(0.923**), Floret length(0.950**) ,Floret diameter(0.872**), No. of corms per plant(0.998**), Corm diameter(0.819**), Weight of corm(0.994**),Number of corms per hectare(0.995**), Number of cormels per hectare(0.990**).

Phenotypic correlation coefficient analysis revealed that Corms yield/plant (g) showed positive significant association Number of leaves at 30DAS(0.885**), Number of leaves at 60DAS(0.876**), Number of leaves90DAS(0.799**), Number of shoot per plant(0.898**), Days to first flowering(0.826**), Rachis length(0.835**), No. Of florets per spike(0.597**) ,Number of spikes per plant(0.915**), Floret length(0.852**) ,Floret diameter(0.819**), No. of corms per plant(0.985**), Corm diameter(0.800**), Weight of corm(0.969**),Number of corms per hectare(0.990**), Number of cormels per hectare(0.972**).

Conclusion

Based on the present investigation it was concluded that the high magnitude of heritability (in broad sense) coupled with high genetic gain was observed for most of traits exhibiting additive genetic effect. The analysis of variance for different quantitative characters reviled significant differences among the genotypes for parameters like Growth, and floret dimeter with Corms weight/plant (g) of gladiolus. The highest corms yield/plant (g/plant) of genotype was observed in Arka Aayush (156.60) followed by P.B Clown and Red Ginger. It was observed that PCV was higher than GCV for all the traits studied highest GCV and PCV is recorded as Number of corm per plant(46.40 and 46.61). In the present study the heritability estimates in broad sense were classified into 3 groups such as high (>75%), moderate (60% - 75%), low (<60%). The heritability estimates were found to be high (more than 75%). Genotypic and phenotypic correlation coefficient analysis revealed that Corms weight/plant (g) showed positive significant association with plant height, number of leaves per plant, number of shoot per plant, rachis length (cm), no. of floret per spike, no. of spike per plant, floret diameter (cm), corm weight per plot (g), weight of mother corm per plot, weight of daughter corm, corm diameter (cm), no. of corm per hectare, no. of cormels per hectare and corm yield/plant at both levels genotypic and phenotypic. Revealed that the highest direct positive effect on Corm Yield/Plant was exhibited by number of leaves per plant, number of shoot per plant, rachis length (cm), days for colour of basal floret, no of floret per spike, no. of spike per plant, corm weight per plot (g), weight of mother corm per plot, and no. of corm per hectare at both levels of genotypic and phenotypic.

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References

1. **Anitha, K., Jegadeeswari, V. and Selvaraj, N., (2017),** Studies on genetic variability, heritability and genetic advance in lisianthus (*Eustoma grandiflorum L.*). Agriculture Update, **12**(2): 471-474.
2. **Archana, B. and Patil, V. S., (2013),** Studies on ethyl methane sulphonate (EMS) induced mutations for enhancing variability of gladiolus varieties (Gladiolus hybridus Hort.) in M1V2 generation. *Karnataka Journal of Agriculture Sciences*, **26** (3): 403-407.
3. **Archana, B. and Patil, V. S. (2016).** Genetic variability and heritability studies in gamma ray in irradiated mutant populations of gladiolus (Gladiolus hybridus Hort.) varieties in M1V2 generation. Green Farming, **7** (2): 388-391.
4. **Archana, B., Patil, A. and Patil, V. S. (2008)**. Studies on Genetic variability analysis in gladiolus hybrids. *Journal of Ornamental Horticulture,* **11**(2): 121-126.
5. **Balamurugan, Rengasamy, P. and Arumugam, T. (2002).** Variability studies in
6. gladiolus. *Journal of Ornamental Horticulture*, **5**(1): 5 38-39.
7. **Balaram, M. V. and Janakiram, T. (2004).** Genetic variability studies in gladiolus genotypes. *Karnataka Journal of Horticulture,* **1**(1): 96-99.
8. **Balaram, M. V. and Janakiram, T. (2009).** Correlation and path coefficient analysis in gladiolus. *Journal of ornamental horticulture*, **12**(1): 22-29.
9. **Balaram, M., Janakiram, T., Vasantha, E., Choudhary, M. L. and Ganeshan, S. (2000)**. Genetic variability among Gladiolus genotypes. National Conference on Gladiolus, 2: 24-25.
10. **Bhatia, R. and Grewal, H. P. S. (2009).** Genetic variability and heritability studies in gladiolus. Indian Agriculturist, **53**(2): 1-6.

11. **Bhujbal, G. B., Chavan, N. G. and Mehetre, S. S. (2013).** Evaluation of genetic variability heritability and genetic advances in gladiolus (Gladiolus grandiflorus L.) genotypes. The Bioscan, **8**(4): 1515-1520.
12. **Bichoo, G. A., John, A. Q. and Wani, S. A. (2002).** Genetic variability in some quantitative characters of gladiolus. *Journal of ornamental horticulture*, **5**(1): 22-24
13. **Bichoo., G. A., Johan, A. Q. and Wani, S. A. (2002).** Correlation studies in Gladiolus.*Journal of Ornamental Horticulture,* **5**(1): 25-27.
14. **Bose, T. K., L. P. Yadav and Pal, P. (2003)**. Commercial flowers. Department Horticulture Bidhan Chandra Krishi. Naya Prokash, 1-33.
15. **C. Gandhi, P.D., and Bharathi, T. U. (2020).** Correlation and Path Coefficient Analysis in Tuberose Cultivars Single. Agricultural Science Digest, **40**(12):134-138.
16. **Cantor, M. and Tolety, J. (2011).** Wild crop relatives: genomic and breeding
17. resources. Plantation and Ornamental Crops, 133-142.
18. **Choudhary, M., Moond and Kumari, A. (2011).** Correlation Studies in Gladiolus. Research in Plant Biology, **1**(4): 68-72.
19. **Choudhary, M., Moond, S. K., Kumari, A. and Beniwal, B. S. (2012).** Genetic variability in quantitative characters of Gladiolus. *International journal of agricultural science*, **8**(1): 138-141
20. **Deepti ,(2000).** Co-efficient of variation, heritability and expected genetic advance in gladiolus. Proceedings of the National Conferences on Gladiolus, 70-71.
21. **Geeta, S. V., Shirol, A. M., Nishani S., Parvati, P. and Varuna, K. J. (2014).** Path coefficient analysis studies in gladiolus. Plant Archives, **14**(2): 1131-1133.
22. **Ghimray, T. S. (2005). Studies on genetic variability in gladiolus.** *Journal of Interacademicia,* **9**(3): 314-317.

23. **Hamilton, A., 1976**. A history of the garden Gladiolus. Garden, 101: 424-428.
24. **Kadam, G. B., Kumar, G., Saha T. N., Tiwari A. K. and Kumar, R. (2014)**. Varietal evaluation and genetic variability studies on Gladiolus. *Indian Journal Horticulture*, **71**(3): 379-384.
25. **Kanawjia, A. and Saravanan, S. (2016).** Studies on genetic variability and character association in Gladiolus sp. New Agriculturist, **27**(1):14-19.
26. **Kispotta, L. M., Jha, K. K., Horo P., Tirkey, S. K., Misra, S. and Sengupta, S. (2017)**. Genetic Variability and Heritability in Gladiolus hybridus. *International Journal of Science,* Environment and Technology, **6**(1): 519 – 528.
27. **Kumar, A., Kumar, A. and Kumar, A. (2019).** Genetic variability, heritability, genetic advance and genetic divergence for yield and its Contributing Traits in Gladiolus (*Gladiolus grandiflorus L.*). *International Journal of Current Microbiology and Applied Science*, **8**(1): 689-701.
28. **Kumar, J., Kumar, R. and Pal, K. (2011).** Variability and character association in gladiolus (Gladiolus grandiflorus L.), Agriculture Science Digest, **31**(4): 280- 284
29. **Kumar, J., kumar, R. and Pal, K. (2011).** Variability and character association in gladiolus (Gladiolus grandiflorus L.). Agricultural science digest, 31: 280 - 284.
30. **Kumar, K. A., Singh, B., Dhaiya, R. and Goswami, A. (2018).** Evaluation of genetic variability, heritability and genetic advances in gladiolus (*Gladiolus hybridus* Hort.) genotypes. *Journal Annals of Horticulture year*, **11**(1): 46-51.
31. **Kumar, M., Kumar, S. and Chaudhary, P. (2015).** Correlation and path analysis study in gladiolus (*Gladiolus hybridus* hort.). *International Journal Agriculture Statistics Sciences*, **11**(2): 527-532.
32. **Kumari, A., Patel, K. S. and Choudhary, M. (2011).** Genetic variability studies in Gerbera.Research in Plant Biology, **1**(5):01-04.

33. **Lepcha, B., Nautiyal, M. C. and Rao, V. K. (2007).** Variability studies in gladiolus under mid hill conditions of Uttarakhand. *Journal of Ornamental Horticulture*, ***10*****(**3): 169- 172.

34. **Lush, J. L. (1940).** Intra-sine correlation and regression of offspring on dams as a method of estimating heritability of characters. American society, 33: 293-301.

35. **Mahajan, R. C., Wadikar, P. B., Pole, S. P. and Dhuppe, M. V. (2011).** Variability, correlation and path analysis studies in sorghum. Research *Journal of Agriculture*

a. *Sciences,* **2**(1): 101-103.

36. **Mahanta, P. and Paswan, L. (1995)**. Studies on variability and heritability of some quantitative characters in Gladiolus. South Indian Horticulture, **41**(3): 166- 168.

37. **Mishra, P., Singh A. K. and Singh, O. P. 2014.** Genetic variability, heritability, Genetic advance, correlation coefficient and path analysis in gladiolus. *Journal of Agriculture and Veterinary Science,* 7: 23-26.

38. **Mishra, P., Singh, A. K. and Singh, O. P. (2014)**. Genetic variability, heritability, Genetic advance, correlation coefficient and path analysis in gladiolus. *Journal of Agriculture and Veterinary Science*, **7**(7): 23-26

39. **Mishra, R. L. and Singh, B. (1989).** Gladiolus In: Commercial flowers. Naya Prakash, Calcutta, India, 267-353.

40. **Naresh, S., Dorajee, A. V. D. Rao, Vijaya V. Baskhar, Paratpara, M. Rao and Uma, K. Krishna (2015).** Genetic variability, heritability and genetic advance in Gladiolus hybrids, Plant Archives, 15: 377-381

41. **Nimbalkar, C. A., Katwate, S. M., Singh, B. R. Kakade, D. and Sand, S. B. G. (2007).** Selection strategy for improvement in economic traits of gladiolus. *Journal of Ornamental Horticulture,* **10**(1): 9-14.

42. **Pal, A., Singh, R. and Pal, K. (2017).** Genetic variability in some quantitative traits of gladiolus, Progressive horticulture, **39**(2): 178-181.
43. **Panchana, P., Kannan, M. and Jawaharlal, M. (2015).** Assessment of genetic and correlation studies in single types of tuberose (Polianthes tuberose L.). *International Journal of Tropical Agriculture,* 33: 763-767.
44. **Panwar, S., Singh, K. P., Jankiram, T. and Namita (2013).** Genetic variability, heritability and genetic advance in African marigold (Tagetes erecta L.) genotypes. Progressive Horticulture, **45**(1): 56-60.
45. **Patra, S. K. and Mohanty, C. R. (2019).** Correlation Studies in Gladiolus. *International Journal of Current Microbiology and Applied Sciences*, **8**(2): 3401-3406.
46. **Pattanaik, S., Paul A. and Lenka, P. C. (2015).** Genotypic and phenotypic variability and correlation studies in gladiolus. *Journal Crop and Weed*, **11**(1): 113-119.
47. **Poornima, C., Kumar, D. P., Thippesha, D. Mahanthesh, B. and Naik, B. H. (2007).** Variability and correlation in different cultivars of China aster (Callistephus chinensis L.). Environment and Ecology, **25**(1): 124-127.
48. **Pragya, K., Bhat, V., Misra, R. L. and Ranjan, J. K. (2010).** Analysis of diversity and relationships among Gladiolus cultivars using morphological and RAPD markers. *Indian Journal of Agriculture Science*, **80**(90): 766-72.
49. **Pratap, M. and Rao, M. A. 2006.** Assessment and variability studies in gladiolus. *Journal of Ornanmental Horticulture,* **9**(2): 145-147.

50. **Rahul, K., Sanjay, K. and Yadav, Y. C. (2012).** Genetic variability, heritability, genetic advance, correlation coefficient and path analysis in gladiolus. *Indian Journal of Horticulture*, **69**(3): 369-373.
51. **Rashmi and Kumar, S. (2014).** Estimation of genetic variability, correlation and path analysis in gladiolus (Gladiolus species L.). *International Journal of Plant Science*, **9**(1): 186-189.
52. **Rashmi, R., Chandrashekar, S. Y., Kumar, H. P. and Geeta, S.V. (2016).** Genetic variability and correlation studies in gladiolus (Gladiolus hybridus L.). Green Farming, **7** (2): 383-387.
53. **Reddy, M. C. S., Hari, P. K. and Kamalakannan, S. (2002).** Genetic variability in crossandra. Advances in Plant Sciences, 15(2): 539-541.
54. **Singh, A. and Singh, S. S. (2018).** Genetic variability studies in gladiolus (Gladiolus grandiflorus L.). Pharma Innovation, **7**(7): 690-693.
55. **Singh, A., and Singh, S. S. (2018).** Genetic variability studies in gladiolus (Gladiolus grandiflorus L.) under Chitrakoot condition. The pharma innovation, **7**(7): 690-693.
56. **Singh, D. and Mishra K. K. (2008).** Genetic variability in quantitative characters in
    a. marigold. *Indian Journal of Horticulture*, **65**(2): 187-192.
57. **Singh, D., Mishra, A. and Meena, B. (2017).** Genetic variability studies in Gladiolus (*Gladiolus hybridus* hort.) under sub humid condition of Rajasthan. *International Journal of Agricultural Science and Research*, 7: 523-528.
58. **Singh, D., Mishra, A. and Meena, B. (2017).** Genetic variability studies in gladiolus (Gladiolus hybridus hort.) under sub humid condition of Rajasthan. *International journal of Agricultural Science and Research*, **7**(1): 523-528
59. **Swetha, S., Kulkarni, B. S., Shiragur, M., Kulkarni, M. S., Mulge, R., Hegde, L.**

and Naik, M. B. N. (2019). Genetic variability studies in gladiolus (*Gladiolus hybridus* Hort.). *Journal of Pharmacongnosy and Phytochemistry*, **9(**1):726- 731.

60. **Vanlalruati , T. Mandal and Pradhan, S. (2013).** Correlation and path coefficient analysis in Tuberose. *Journal of Crop and Weed*, **9**(2):44-49.
61. **Vanlalruati, Mandal, T. and Pradhan, S. (2013).** Correlation and path coefficient analysis in Tuberose. Journal of Crop & Weed, 9: 44-49
62. **Verty, P., Prasad, V. M., Collis, J. P. and Nazir, M. (2017).** Correlation Analysis in Gladiolus (*Gladiolus grandiflorus L*.). *International Journal of Current Microbiology Applied Sciences*, **6**(9): 743-749.
63. **Verty, P., Prasad, V. M., Collis, J. P. and Nazir, M. (2017).** Correlation Analysis in Gladiolus (*Gladiolus grandiflorus L*). Agriculture Research & Technology: *Open Access Journal*, **10**(4): 1-6.
64. **Verty, P., Prasad, V. M., Collis, J. P. and Nazir, M. (2017).** Genetic Variability for Some Quantitative Characters in Gladiolus (*Gladiolus grandiflorus L*.). *International journal of current microbiology and applied sciences*, **6**(9): 750- 754.
65. **Verty, V., Prasad, V. M., Collis, J. P. and Nazir, M. (2017).** Correlation Analysis in Gladiolus (*Gladiolus grandiflorus L*.). Agriculture Research and Technology, **10**(4):34-38.
66. **Vikas, H. M., Patil, V. S., Agasimani, A. D. and Praveenkumar, D. A. (2011).** Studies on genetic variability in Dahlia (*Dahlia variabilis L*.). *International Journal of Security and Network*, **2**(2): 372-375.
67. **Vinodh, S. and Kannan, M. (2019).** Varibility studied in Crossandra (*Crossandra infundibuliformis L.). Journal of Pharmaconosy and Phytochemistry*, **9**(1): 312-314.

68. **Zaharia, A., Cantor, M., Borsai, O., Erzsebet, B., and Jucan, Y. (2017).** Correlation analysis of different morphological characters among cultivars and hybrids of *Gladiolus hybridus* Hort. Romanian Biotechnological Letters, **23**(4): 13723- 13727.
69. Singh V, Singh D, Wesley J. Study of Evaluation of Genetic Variability of Gladiolus Cultivars under Agro-climatic Conditions of Prayagraj, India. Int. J. Plant Soil Sci. [Internet]. 2023 Aug. 19 [cited 2024 Jun. 11];35(19):327-35. Available from: https://journalijpss.com/index.php/IJPSS/article/view/3559
70. Srinidhi R, Singh D. Study On Evaluating Genetic Variability of Gladiolus (Gladiolus grandiflorus L.) Cultivars under Agro-Climatic Conditions of Prayagraj. J. Exp. Agric. Int. [Internet]. 2024 May 18 [cited 2024 Jun. 11];46(6):647-55. Available from: https://journaljeai.com/index.php/JEAI/article/view/2520
71. Chaudhary V, Kumar M, Sharma S, Kumar N, Kumar V, Yadav HK, Sharma S, Sirohi U. Assessment of genetic diversity and population structure in gladiolus (Gladiolus hybridus Hort.) by ISSR markers. Physiology and Molecular Biology of Plants. 2018 May;24:493-501.
72. Rymer PD, Manning JC, Goldblatt P, Powell MP, Savolainen V. Evidence of recent and continuous speciation in a biodiversity hotspot: a population genetic approach in southern African gladioli (Gladiolus; Iridaceae). Molecular Ecology. 2010 Nov;19(21):4765-82.
73. Patel A, Singh D, Wesley CJ. Genetic Variability of Gladiolus (Gladiolus grandifloras L.) Varieties Under Prayagraj, Uttar Pradesh Agro-Climatic Conditions. International Journal of Environment and Climate Change. 2023 Aug 18;13(10):562-70.

LIST OF ABBREVIATIONS

%	:	Percent
ANOVA	:	Analysis of Variance
CD	:	Critical difference
cm	:	Centimeter
CV	:	Coefficient of Variation
df	:	Degree of Freedom
EMS	:	Error Mean Sum of Squares
ESS	:	Error Sum of Squares
ESP	:	Error Sum of Products
et al	:	And co-workers
G	:	Gram
RBD	:	Randomized Block Design
FYM	:	Farm Yard Manure
GA	:	Genetic Advance
PV	:	Phenotypic Variance
PCV	:	Phenotypic Co-efficient Variation
GCV	:	Genotypic Co-efficient Variation
H_2	:	Heritability
ha	:	Hectare
i.e.	:	That is

Kg	:	Kilogram
L	:	Liter
M	:	Meter
m^2	:	Meter square
mg	:	Miligrams
ml	:	Mililitre
NHB	:	National Horticulture Board
P	:	Phosphrus
Sem	:	Standard error of mean
Viz	:	Namely
Wt.	:	Weight
WP	:	Wettable powder
ha^{-1}	:	Per Hectare
$0^{\circ}C$	:	Degree Centigrade / Degree Celsius

APPENDIX

APPENDIX

Plant height (cm) 30 DAS

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.43	0.21		
Treatment	14	1500.03	107.15	25.99	0.000
Error	28	115.45	4.12		
Total	44	1615.90	36.73		

Plant height (cm) 60DAS

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	40.42	20.21		
Treatment	14	2448.80	174.91	22.60	0.000
Error	28	216.71	7.74		
Total	44	2705.92	61.50		

Plant height (cm) 90DAS

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	34.15	17.08		
Treatment	14	2413.78	172.41	9.24	0.000
Error	28	522.24	18.65		
Total	44	2970.17	67.50		

Number of leaves 30DAS

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.13	0.07		
Treatment	14	578.90	41.35	372.07	0.000
Error	28	3.11	0.11		
Total	44	582.14	13.23		

Number of leaves 60DAS

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.09	0.05		
Treatment	14	324.41	23.17	111.15	0.000
Error	28	5.84	0.21		
Total	44	330.33	7.51		

Number of leaves 90DAS

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	1.20	0.60		
Treatment	14	197.68	14.12	23.29	0.000
Error	28	16.98	0.61		
Total	44	215.85	4.91		

Number of shoot per plant

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.00	0.00		
Treatment	14	6.99	0.50	127.83	0.000
Error	28	0.11	0.00		
Total	44	7.10	0.16		

Days taken for 50% sprouting

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.00	0.00		
Treatment	14	19.50	1.39	21.75	0.000
Error	28	1.79	0.06		
Total	44	21.30	0.48		

Days to first flowering

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.00	0.00		
Treatment	14	278.64	19.90	77.57	0.000
Error	28	7.18	0.26		
Total	44	285.83	6.50		

Rachis length(cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	35.41	17.71		
Treatment	14	4866.66	347.62	74.88	0.000
Error	28	129.98	4.64		
Total	44	5032.05	114.36		

No. of days for emergence of flower spike

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	28.60	14.30		
Treatment	14	909.91	64.99	7.18	0.000
Error	28	253.47	9.05		
Total	44	1191.98	27.09		

Days to show color of basal floret

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	21.37	10.69		
Treatment	14	747.14	53.37	4.86	0.000
Error	28	307.38	10.98		
Total	44	1075.89	24.45		

No. florets per spike

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.87	0.43		
Treatment	14	119.13	8.51	29.40	0.000
Error	28	8.10	0.29		
Total	44	128.10	2.91		

No. of spike per plant

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.00	0.00		
Treatment	14	6.54	0.47	97.82	0.000
Error	28	0.13	0.00		
Total	44	6.68	0.15		

Floret length(cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.09	0.04		
Treatment	14	37.64	2.69	15.48	0.000
Error	28	4.86	0.17		
Total	44	42.58	0.97		

Floret diameter(cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.64	0.32		
Treatment	14	41.87	2.99	23.48	0.000
Error	28	3.57	0.13		
Total	44	46.08	1.05		

No. of corms per plant

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.00	0.00		
Treatment	14	9.98	0.71	138.13	0.000
Error	28	0.14	0.01		
Total	44	10.12	0.23		

Corm diameter(cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.07	0.03		
Treatment	14	41.42	2.96	81.43	0.000
Error	28	1.02	0.04		
Total	44	42.50	0.97		

Weight of corm(g)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	1.12	0.56		
Treatment	14	2518.02	179.86	41.20	0.000
Error	28	122.22	4.37		
Total	44	2641.36	60.03		

Cormel diameter(cm)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	0.00	0.00		
Treatment	14	14.18	1.01	214.70	0.000
Error	28	0.13	0.00		
Total	44	14.31	0.33		

No. of corms/hectare

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	41687083	20843542		
Treatment	14	277111786672	19793699048	132.61	0.000
Error	28	4179296501	149260589		
Total	44	281332770256	6393926597		

Number of cormels/hectare

Source of Variation	D F	Sum of Squares	Mean Squares	F-Calculat ed	Significan ce
Replication	2	113163458479	56581729239		
Treatment	14	103448637457048	7389188389789	266.28	0.000
Error	28	776984881701	27749460061		
Total	44	104338785797228	2371336040846		

Corms yield/plant(g)

Source of Variation	DF	Sum of Squares	Mean Squares	F-Calculated	Significance
Replication	2	27.82	13.91		
Treatment	14	55049.52	3932.11	330.31	0.000
Error	28	333.32	11.90		
Total	44	55410.65	1259.33		